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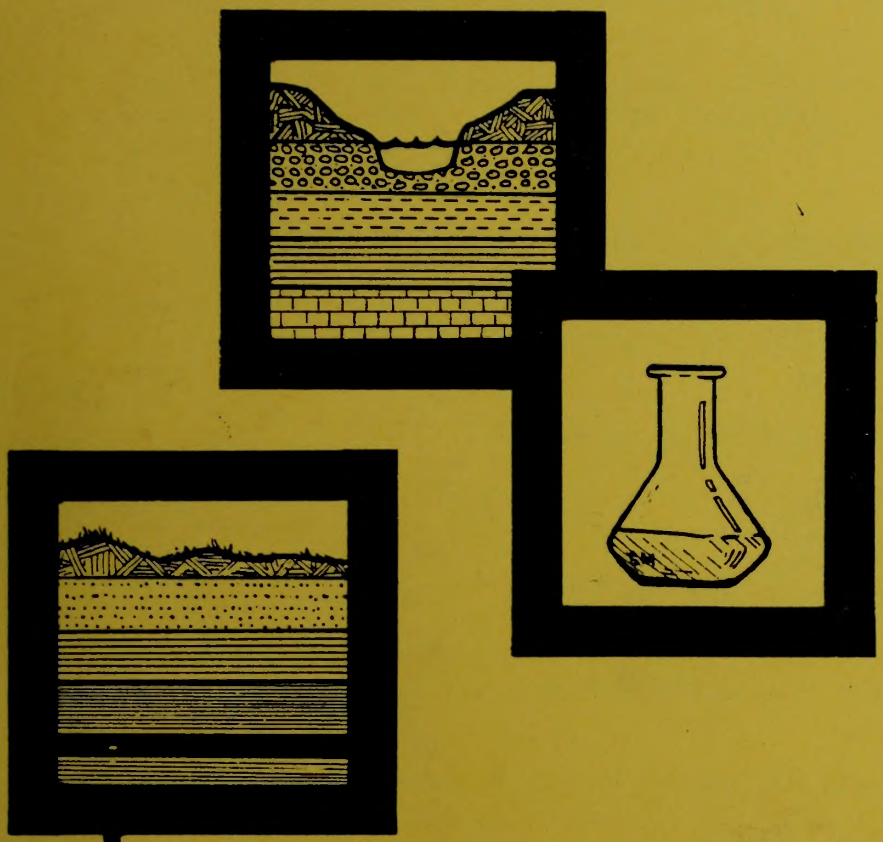

FY-82 WORK PLAN

U.S. Geological Survey

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Bureau of Land Management

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Preface

The Bureau of Land Management each year requires data collection and analysis and technical consulting services of its sister agency, the U.S. Geological Survey. For fiscal year 1982 services are requested of the GS's Water Resources Division.

The Work Plan includes both Federal Coal Management Program (abbreviated CMP in summaries) and non-CMP work items. Non-CMP work items are identified by a separate BLM appropriation code included in each work item description. Agency technical contacts for the 1982 BLM/GS contract are as follows:

Bureau of Land Management

Bruce Van Haveren (Supv. Hydrologist), Contracting Officer's Authorized Representative, Denver Service Center (FTS 234-2374).

U.S. Geological Survey

Water Resources Division

Donald A. Goolsby, Regional Energy Coordinator, Central Region (FTS 234-4118)

Donald L. Coffin, Regional Program Officer, Central Region (FTS 234-4118)

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SUMMARY OF BLM FUNDS
WATER RESOURCES DIVISION
1982

State	CMP	Watershed (4340)	Oil Shale	Total
Alabama	$ 232,000	-		$ 232,000
Colorado	370,000	$122,365	$99,000	591,365
Idaho	-	29,820		29,820
Montana	378,000	-		378,000
Nevada	-	62,000		62,000
New Mexico	240,000	-		240,000
North Dakota	186,000	-		186,000
Ohio	23,000	-		23,000
Oklahoma	118,000	-		118,000
Utah	501,000	57,100		558,100
West Virginia	74,000	-		74,000
Wyoming	188,000	-		188,000
Central Region	5,000	-		5,000
TOTALS	$2,315,000	$271,285	$99,000	$2,685,285

ANNUAL WORK PLAN

USGS WATER RESOURCES DIVISION AND BLM
Fiscal Year 1982

AUTHORITY

The General Agreement between the Bureau of Land Management (BLM) and the Geological Survey (GS), dated August 15, 1974, is considered the basis for this Work Plan.

PURPOSE

The purpose of this Work Plan is to specify the nature and amount of assistance to be provided by the GS to BLM during FY 82.

SCOPE

This work plan includes all services to be provided by the GS under the CMP program to BLM in fiscal year 1982 in the States of Alabama, Colorado, Montana, New Mexico, North Dakota, Ohio, Oklahoma, Utah, West Virginia, and Wyoming. Also included are non-CMP work items for the states of Colorado, Idaho, Nevada, and Utah.

The GS will provide the services, including personnel, equipment, supplies, and facilities, to conduct water resources investigations in areas designated by the BLM. Services will include installation, operation, and maintenance of surface-water gages, ground-water wells, and climate stations, as well as water-quality data collection and analysis.

PROCEDURE

Fiscal year 1982 is the eighth year of this cooperative effort. Some work that began in earlier fiscal years will be continued in fiscal year 1982, while some projects may be dropped. New studies will begin in fiscal year 1982, some of which will carry into fiscal year 1983 and beyond. These decisions will be made in joint meetings among the GS District and BLM State offices and the Denver Service Center. The annual work plan is developed by the Denver Service Center after negotiations with BLM field offices to determine needs and GS field offices to determine capabilities, recommended hydrologic procedures, and for coordination with other studies conducted by the GS in other programs. The development of budgets takes into account the program needs of both agencies and funds available to meet those needs. When mutual interests are strong, funds from both agencies are applied. Funds tabulated in the work order, however, represent only those from BLM.

Field investigative procedures will be standard GS water resources investigation techniques.

REPORTS

Reporting will generally be standard GS report procedures with some deviations that are detailed in the Annual Work Plan.

Semiannual progress reports will be prepared by each Water Resources Division district and routed through the Central Region to the Contracting Officer's Authorized Representative (BLM). Due dates for these reports will be April 30, 1982, and September 24, 1982. The GS will provide the appropriate BLM State Office with a copy of each progress report.

In addition, a separate report on the progress of the precipitation-runoff modeling efforts in all states, covering the status of the small watersheds calibration, will be prepared jointly by the Precipitation-Runoff Modeling Project (USGS) and the Denver Service Center (BLM) and submitted to BLM-Headquarters by September 24, 1982.

Prior to publishing any work involving BLM funds, the GS will forward copies of the report to the Contracting Officer's Authorized Representative and to the appropriate BLM State Office contact for review and approval.

FUNDING

BLM will reimburse GS for actual expenses incurred in providing the service covered in this work order, not to exceed $2,685,285 upon receipt of SF 1081. Details of cost items for each study in each state are presented in the Annual Work Plan.

Alabama

ALABAMA

SUMMARY OF FUNDS
WATER RESOURCES DIVISION

Southern Appalachian Region

Project	CMP Funding
Surveillance of Hydrologic Changes Resulting from Mining of Federal Coal in the Warrior Coal Field, Alabama	$166,000
Watershed Modeling of Potential Federal Coal Mining Areas in North-Central Alabama	66,000
TOTAL	$232,000

Total for State of Alabama: $232,000

ALABAMA

, BLM, ESO Director (FTS-235-2833)
Jerry Coalgate, BLM, ESO Technical Investigations Coordinator (FTS-235-2868)
C.A. (Jerry) Pascale, WRD District Chief (FTS 229-2957)

I. Surveillance of Hydrologic Changes Resulting from Mining of Federal Coal in the Warrior Coal Field, Alabama

Robert Kidd, WRD Project Chief (FTS 229-2976)

A. Location: The Warrior Coal Field in Tuscaloosa, Fayette, Walker, and Jefferson Counties, Alabama.

B. Objective: Collect and interpret basic data on water resources to aid the Bureau of Land Management (BLM) in its responsibility for preparing an Environmental Impact Statement (EIS) beginning in FY 1983.

C. Procedures: Standard U.S. Geological Survey methods will be used to collect streamflow, water quality, ground water, and precipitation data.

1. Surface Water

a. Streamflow and water quality data will be collected at approximately 20 sites (quarterly) and 7 sites (monthly).

b. Use regression equations to determine range of surface water quality impacts that can occur as a result of mining.

c. During periods of low-flow measure flow emanating from mines to approximate the changes in ground-water storage resulting from mining.

2. Ground Water

a. Water-level measurements and water sample collections for chemical analysis will be made in selected wells near concentrations of Federal mineral ownership.

b. Where wells are located near mines, a correlation between mining and ground water impacts will be made as data becomes available.

3. Sediment

a. Sediment data will be collected at selected sites.

b. Regression equations will be used to estimate the magnitude of impact sediment will cause as a result of mining.

4. General

a. Establish a network of rain gages for precipitation data.

b. Tabulate and interpret on a current basis all data collected as a part of this project and similarly related projects in an effort to improve techniques for predicting effects of mining on the hydrology.

c. Contract aerial photography to define degree of mining and land use changes in principal basins monitored and other land under Federal mineral ownership.

d. Coordinate with other agencies to avoid data collection duplication and to inform them of project objectives and activities.

D. Report Products: All collected data will be placed in computer storage on an ongoing basis and will be published in the annual data reports, "Water Resources Data for Alabama." An interpretive report on the hydrology of the study area and covering the period of data collection from October 1981 through September 1983 will be "completed" by September 30, 1984. "Completed" means that the report has received colleague review and the Director's approval so draft copies will be available for BLM's use for the EIS. The report will define present hydrologic conditions and effects of mining on hydrology. Where feasible, project findings will be incorporated into papers prepared for presentation to other government agencies, universities, and professional organizations.

E. Distribution of Funds:

Salaries	$ 93,400
Travel	3,900
Aerial Photography	5,900
Data Processing	2,200
Laboratory Services	57,600
Equipment & Supplies	3,000
Total	$166,000

II. Watershed Modeling of Potential Federal Coal Mining Areas in North-Central Alabama

Robert Kidd, WRD Project Chief (FTS 229-2976)

A. Location: The Warrior Coal Field in Tuscaloosa, Fayette, and Walker Counties.

B. Objectives: The objectives of this project are: (1) to test the transferability of the calibrated rainfall-runoff model to watersheds underlain chiefly by the Coker Formation, (2) to calibrate the rainfall-runoff model for simulating streamflow in basins underlain primarily by the Pottsville Formation, and (3) to develop and calibrate a water quality model based on regression relationships for simulating solute loads. The project will use basic data collection in the surveillance project to operate the model.

C. Procedures:

1. To test model transferability in a "Coker Type" hydrological environment, a site in the Turkey Creek basin will be monitored during FY 1982.

2. To calibrate the model for basins underlain chiefly by the Pottsville Formation, monitoring will continue as part of the Surveillance Project in Bear Creek basin, representing an unmined area and Blue Creek basin, a mined area.

3. The Hydrologic Surveillance Project will supplement these stations with three continuous surface water sites and ten recording rain gages.

4. A water quality subroutine module based on regression relationships will be used to estimate changes in water quality.

D. Report Products: Data collected through this project will be placed in computer storage and be available to other agencies and organizations. An administrative report will be prepared by September 30, 1982.

E. Distribution of Funds:

Salaries	$ 53,900
Travel	4,600
Data Processing	6,700
Equipment and Supplies	800
Total	$ 66,000

Colorado

COLORADO

SUMMARY OF FUNDS
WATER RESOURCES DIVISION

Project No.	CMP	Other (4340) Salinity	Other (4340) State	Oil Shale Program
Hydrologic Modeling (CO-113)				
Foidel, Middle Cr.	$ 48,900	---	---	
Taylor, Wilson & Jubb Cr.	25,600			
Hayden Gulch	25,500			
Ground-Water Studies of Coal-Resource Areas Seismic Relection Study (CO-118)	45,000	---		
Hydrology of Coal Spoil Piles (CO-114)	20,000	---	---	
Hydrologic Characterization Yost Area (CO-138)	75,000			
Synoptic WQ Program Yampa River Valley (CO-113)	60,000			
Hydrology of Coal-Bearing Aquifers, Denver Basin (CO-157)	70,000			
Colorado Salinity Program				
Salt Creek Salinity Control	---	$ 11,450	---	
Water-Quality Stations	---	41,365	---	
Operation of BLM Stations in San Luis Valley	---	---	$33,900	
Hydrologic Investigation of Badger Creek	---	---	14,700	
Flow and Water Quality Characteristics of Selected Western Colorado Streams			20,950	
Oil Shale Hydrologic Investigations				$99,000
Totals	$370,000	$ 52,815	$69,550	$99,000

Total for the State of Colorado: $591,365

COLORADO

George C. Francis, BLM State Director (FTS-837-4325)
Rhio Jackson, BLM Technical Investigations Coordinator (FTS 327-4888)
James F. Blakey, WRD District Chief (FTS 234-5092)

I. Hydrologic Modeling

Randolph S. Parker, WRD Project Chief (FTS 234-3487)

A. Objectives: To define the hydrologic system of the basin, interrelating surface-water flow, ground water, precipitation, and climate. The availability and quality of the water resources in the basin will also be defined. This information will be used to assess the premining hydrologic condition of the basin. Some of these data will be related to present and future mining operations to assess effects of mining on basin hydrology.

For FY 82 the hydrologic monitoring program will be continued. Data on surface-water quantity and quality and area climate will be collected.

Hydrologic modeling efforts have concentrated on defining a procedure for calibration of all the watersheds. This procedure has been set and used on three of the basins and is being extended to the others.

B. Study Watersheds

1. Foidel and Middle Creek: Discharge, water temperature, and specific conductance are continuously monitored at three surface-water gaging stations. Monthly sediment samples are at the upper Foidel Creek and the Middle Creek stations, and sediment samples at the lower Foidel Creek station are collected by an automatic suspended-sediment sampler. Routine water-quality sampling is done at all three stations.

A climatological station operated in Foidel Creek basin measures precipitation, air temperature, wind, and solar radiation. A second precipitation gage is operated on the rehabilitation study area, and a third precipitation gage is installed in Middle Creek. Snow course data are also being collected.

a. Distribution of Funds:

Salaries	$ 19,000
Travel	3,100
Vehicles	3,000
Operation & Maintenance of Gages	8,000
Laboratory Analyses	12,000
Data Processing & Modeling	3,800
Total	$ 48,900

2. Taylor, Wilson, Jubb Creek Basin: Discharge, water temperature, and specific conductance are continuously monitored at Wilson, Taylor, and Jubb Creeks, and operation will continue. An automatic suspendedsediment sampler is installed at the Wilson Creek station. Routine water-quality sampling will be continued.

Air temperature, precipitation, soil temperature, wind, and solar radiation are measured at the climatological station operated in Wilson Creek basin. A second precipitation gage is operated in the headwaters of Wilson Creek. Snow course data are also collected.

a. Distribution of Funds:

Salaries	$15,800
Travel	2,100
Vehicles	3,000
Laboratory Analyses	2,000
Data Processing	2,700
Total	$25,600

3. Hayden Gulch: For FY 82 the hydrologic monitoring program will be continued with data collected on surface-water quantity and quality, and precipitation.

This area, between Foidel-Middle and Taylor-Wilson Creeks, has been chosen to complete the hydrologic network for northwestern Colorado.

Hubberson Gulch and Watering Trough Gulch were selected as basins with proposed coal development. Stokes Gulch, selected as being representative of the dryland farming areas of the region, will provide data to compare the hydrologic impacts of coal development with those of Yampa Basin agriculture development.

A surface-water gaging station, installed on Stokes Gulch, monitors discharge, water temperature, and specific conductance. Monthly water samples are collected and analyzed for major chemical constituents, while quarterly water samples will be collected and analyzed for major constituents and trace metals. Monthly sediment samples are collected at the stations on Hubberson and Watering Trough Gulches. Sediment samples at the Stokes Gulch station are collected by an automatic suspended-sediment sampler.

a. Distribution of Funds:

Salaries	$15,000
Travel	3,500
Equipment	3,000
Computer	2,000
Laboratory	2,000
Total	$25,500

C. Hydrologic Modeling Total Funding: $100,000

D. Report Products: FY 82 report on the calibration process of the model is now in review. A report using the model in both a temporal and spatial framework in the active coal area of the Yampa Valley will be available for review by the end of FY 82.

II. Ground Water Studies of Coal Resource Areas

Robert S. Williams, WRD Project Chief (FTS 234-3815)

A. Location: Colorado

B. Objectives

1. Seismic Refraction

a. Define the extent and boundary conditions of alluvium in coal mine areas.

b. Define alluvial water table.

The overall objective of the study is to evaluate the use of seismic refraction in collecting hydrogeologic data in alluvium. This study will aid in the rapid assessment of alluvial valley conditions.

2. Other Studies

The following subprojects have been discontintued due to reduced funding:

Grand Mesa	Alluvial Aquifer Characterization
Raton Mesa	McCallum Hydrogeology
	Well Testing Methods

C. Report Products FY 82: The following reports will be available for review in FY 82.

1. Hydrogeology of Collom Gulch, March 1982.
2. Hydrogeolgoy of the Williams Fork Mountains.
3. Seismic Refraction Techniques for Evaluating Alluvial Aquifers, September 1982.

D. Distribution of Funds:

Salaries	$22,200
Travel	4,300
Equipment	1,700
Computer	4,000
Manuscripts and Illustrations	$12,800
Total	$45,000

III. Hydrology and Reclamation Potential of Coal Spoil Piles

Robert S. Williams, WRD Project Chief (FTS 234-3815)

A. Location: Routt County, Colorado

B. Objectives: Threefold. First, the hydrologic characteristics of coal spoils piles will be defined, and the quantity, quality, and timing of water movement through the spoils will be examined and compared to the same parameters for undisturbed basin areas.

The second objective will be assessing use of cuttings from holes drilled in undisturbed areas to predict the water-quality changes that will occur after mining these areas. Water-quality changes in existing spoils piles will be compared to quality changes in water passed through a column of cuttings from adjacent areas. This technique would provide a relatively inexpensive method for predicting water-quality changes in areas to be mined. These data would then be used to predict the impact of mining on total basin hydrology.

The third objective is to examine effects of reclamation procedures on spoils-piles hydrology. Different land-surface treatments and vegetative covers will be applied and evaluated to determine their effectiveness in reclaiming disturbed areas and their water-quality impact.

Because of funding reduction, all data collection has been discontinued for this study.

C. Report Products: An interpretive report will be available for BLM review in September 1982.

D. Distribution of Funds:

Salaries	$ 12,100
Travel	1,000
Computer	1,700
Manuscripts and Illustrations	5,200
Total	$ 20,000

IV. Hydrologic Characterization of the Yost Area, Yampa River Valley, Colorado

Robert S. Williams, WRD Project Chief (FTS 234-3815)

A. Location: Routt County, Colorado

B. Objective: The study will define and interpret the undisturbed natural hydrologic regime of an area which is to be strip mined at some later date.

The purpose of the study is to define the hydraulic and the hydrologic characteristics of shallow, alluvial, overburden, underburden, and coal aquifers, and the interaction of these aquifer systems to each other and to surface water.

C. Monitoring: The proposed mine is located 8 mi south of Hayden, Colorado, within the Sage Creek drainage. Along Sage Creek alluvial wells are being monitored in conjunction with other projects. Twenty-eight bedrock wells have been drilled at the study site. Each well will be monitored for water level. Two sites have continuous recorders. Water samples will be analyzed for major cations, major anions, and trace metals.

Soil-water tubes are installed at different soil and vegetation ecological units within the mine site. A neutron probe will be used to measure the soil-water content.

A stream-gaging station with a flume is installed at the mine boundary where Sage Creek flows off of the mine property. Water-quality samples and sediment samples will be obtained at this location.

A climate station is established in the basin to be mined. Monitored at the site will be precipitation; maximum, minimum, and mean daily temperature; relative humidity; solar radiation; and wind speed. Two recording precipitation gages are installed at a low and high elevation in the basin. Snowcourses will be run at these sites.

The frequency of data gathering trips has been reduced. All data collection associated with alluvial aquifers has been discontinued.

D. Report Products: A basic data report has been approved and will be published in FY 82. An interpretive report is scheduled for FY 84.

E. Distribution of Funds:

Salaries	$ 58,000
Travel	5,200
Equipment	1,700
Computer	4,000
Laboratory	6,100
Total	$ 75,000

V. Synoptic Water-Quality Program for the Coal Region of the Yampa River Valley, Colorado

Randolph S. Parker, WRD Project Chief (FTS 234-3487)

A. Location: Routt and Moffat Counties, Colorado

B. Objectives

1. To collect data on the dissolved chemistry of a number of small watersheds throughout the area south of the Yampa River.

2. To compare absolute values and relationships already developed for the six stations with longer term record.

3. To identify regions, if they exist, of homogeneous disolved water chemistry based on the comparisons made in objective 2. Data collected will be instantaneous discharge, field parameters, and the major dissolved ions.

   Sampling will be repeated at each site to obtain approximately eight samples at various discharges. Regression relations between specific conductance and each dissolved constituent for each site will be developed. These individual ion relations at a site are then statistically compared among sites to group the basins into regions.

4. To redo the above three obejctives with respect to the suspended system (trace metals and sediment) for a reduced number of sites.

C. Report Products: A data report identifying the sites and reporting the dissolved water quality data at these sites will be available by May 1982. In addition, an open-file report will be written interpreting the major dissolved oxygen constituents. This report will be available for review by November 1982.

D. Distribution of Funds:

Salaries	$ 30,000
Travel	8,000
Vehicle	7,000
Equipment	3,000
Laboratory	10,000
Computer	2,000
Total	$ 60,000

VI. Hydrology of Coal-Bearing Aquifers in the Denver Basin

Robert S. Williams, WRD Project Chief (FTS 234-3815)

A. Location: The study area is located primarily in Weld, Adams, Arapahoe, Douglas, Elbert, and El Paso Counties and is known as the Denver Basin.

B. Problem: The Bureau of land Management is required to determine the suitability for leasing of Federally-owned coal lands. The hydrologic system is one component of the natural regime which needs to be evaluated in the suitability assessment. This study is to provide interpretive information that will allow BLM personnel to make reasonable estimates of potential hydrologic impacts of surface mining of Federally-owned coal.

Generalized evaluations of the hydrology of the Denver Basin have been made by the Colorado State Water Resources Division and by the U.S. Geological Survey, Water Resources Division. At this time more definitive work is needed to evaluate hydrologic systems closely associated with areas which will be mined for coal.

C. Objective: The objective of the investigation is to provide interpretive information on the hydraulic and chemical characteristics of the bedrock aquifers in and adjacent to the mineable coal seams in the Denver and Laramie Formations of the Denver Basin. Specifically, the study will:

1. Evaluate the effects of mine dewatering on aquifers in the area of coal mining.

2. Define the water quality of aquifers which will be affected by coal mining.

3. Hypothesize potential changes in ground-water quality due to coal mining.

D. Approach

1. The hydraulic characteristics of the aquifers will be investigated using existing information to refine and update the transmissivity and storage coefficient estimates. These data will be incorporated into analytical equations capable of calculating families of curves relating drawdown, distance from the pumped well, and duration of pumping. This work will provide a means of estimating the pumping rates required to dewater a mine site, the impact of differing pumping rates on nearby wells, and the temporal changes in water levels in surrounding areas. This will be done on a basin-wide level so as to have maximum transfer value to any mine lease site in the basin.

2. The geochemistry of the basin will be investigated to provide a basin-wide definition of predevelopment ground-water quality. This will provide bench mark data for the four principal aquifers in the basin and also will provide a first evaluation of the water chemistry within, and adjacent to the coal seams provided that wells or seeps associated with the coal seams can be found. Existing fragmentary data indicate that water in the coal seams is of inferior quality to that occurring in overlying and underlying sandstone strata. The extent and magnitude of this condition is not known, but could lead to water-quality degradation in mined areas. Water samples will be collected from existing wells or shallow wells to provide additional chemical data. Water chemistry requirements for domestic, municipal, industrial, and agricultural uses can be employed to determine the suitability of existing ground water for these purposes.

3. Spoil pile water-quality information is available from other areas of coal mining. Water equilibrium models and mass balance models are also available. Although no spoil pile information is available in the area of study, the information and models previously mentioned will be used to hypothesize the potential impacts of coal mining on the ground-water quality in the area of study.

E. Report Products: An open-file report will be available for review by September 1982. The report will provide interpretative analysis of the data with the objective of providing information that will allow the reader to make reasonable estimates of the hydrogeologic impacts of proposed coal-resource development in the Denver Basin.

F. Distribution of Funds:

Salaries	$43,500
Travel	1,700
Vehicles	3,500
Laboratory	8,700
Computer	900
Manuscript and Ilustrations	8,500
Supplies	$ 3,200
Total	$70,000

VII. Colorado Salinity Program

Daniel L. Collins, WRD Project Chief (FTS 322-0302)

A. Salt Creek Salinity Control Project

1. Location: One gaging station will be operated to provide streamflow and water quality information on Salt Creek, which flows out of Sinbad Valley in Colorado. Six stations--two on Potter Creek, one on West Gypsum Creek, one on Vermillion Creek, and two on Onion Creek--which flow out of Fisher Valley in Utah, were discontinued October 1, 1981.

2. Objectives: The station consists of a digital water level recorder to measure stream stage and a Manning sampler to obtain water quality and sediment samples. The stage-discharge relationship will be verified by periodic current meter and slope-area measurements. The station will be inspected biweekly with streamflow measurements and water-quality samples obtained at least monthly. This station will provide data on streamflow quantity and the chemical character of the water in this stream. Daily maximum and minimum specific conductance and stream temperature data are available from a two-parameter mini-monitor. Additionally, a recording rain gage is operated in the watershed.

3. Report Products: Provide BLM with copies of all tabulated data as they are completed. All discharge and water quality data will be published annually in "Water Resources Data for Colorado."

4. Distribution of Funds:

Salaries	$ 4,880
Travel	700
Equipment (includes rental costs)	2,820
Computer	100
Laboratory	2,950
Total:	$11,450

B. Colorado Water-Quality Stations

Daniel L. Collins, WRD Project Chief (FTS 322-0302)

1. Location: Hydrologic information pertaining to streamflow and water quality will be collected at five sites.

   a. 09160000--Badger Wash observation reservoir 4-a, Prairie Dog site, near Mack, Colo.
   b. 09160500--Badger Wash observation reservoir No. 12, Middle basin site, near Mack, Colo.
   c. 09161000--Badger Wash observation reservoir No. 2-A, West Twin site, near Mack, Colo.
   d. 09153330--West Salt Creek near Carbonera, Colo.
   e. 09153400--West Salt Crek near Mack, Colo.

   Stations operated previously on Potter Creek (2), West Gypsum Creek (1), Vermillion Creek (1) and Onion Creek (2) which flow out of Fisher Valley in Utah, were discontinued October 1, 1981.

2. Objectives: Each station consists of a digital water-level recorder to measure stream stage and a Manning sampler to obtain water quality and sediment samples. A stage-discharge relationship will be developed for each site from current and slope-area measurements. Each station will be inspected biweekly with streamflow measurements and water-quality samples obtained at least monthly. These stations will provide data on streamflow quantity and the chemical character of the water in these streams.

   A recording rain gage is operated in each of five gaged watersheds in western Colorado. Two parameter minimonitors (electrical conductivity and temperatures) are operated at six of the gaging stations in western Colorado.

3. Report Products: BLM will be provided with copies of all tabulated data as it is completed. All discharge and water quality data will be published annually in "Water Resources Data for Colorado." A copy of the field survey notes will be provided to BLM for computing deposition.

4. Distribution of Funds:

   a. Object Classes:

Salaries	$18,100
Travel	2,450
Equipment (includes rental costs)	9,800
Computer	400
Laboratory	10,615
	$41,365

b. Work Element:

Surface-Water Stations	$ 9,600
Two parameter mini-monitors	13,920
Automatic Sampler Operation	10,695
Raingages	1,900
Station reestablishment	4,750
Reservoir sediment survey[1/]	500
Total	$41,365

1/ Survey to be made of three Badger Wash reservoirs to provide the data necessary to determine sediment deposition in the reservoirs. Work to be done by one BLM and one USGS hydrologist and level-note copy provided to BLM.

VIII. Operation of BLM Stations in San Luis Valley

Jerry L. Hughes, WRD Project Chief (FTS 323-9345)

A. Location: Eight study sites in San Luis Valley: two reservoir sites--change in contents; four reservoir sites--inflow; and two daily streamflow sites on San Luis Creek. Automatic sediment samplers are operated on San Luis Creek sites during spring and summer months. Recording rain gages are operated at seven sites.

B. Objective: To determine effects of changes in land use on the runoff from the small drainage areas. Daily flow and rainfall will be tabulated for the six reservoir sites. Two streamflow sites and one rainfall site are located on San Luis Creek to monitor runoff in this area.

C. Distribution of Funds (CO-050-4340-5225):

Salaries	$23,500
Travel	4,200
Equipment	1,400
Computer	2,000
Laboratory	2,800
Total	$33,900

IX. Hydrologic Investigation of Badger Creek

Jerry L. Hughes, WRD Project Chief (FTS 323-9345)

A. Location: Badger Creek, tributary to Arkansas River.

B. Objective: Determine surface-water quantity and quality characteristics of Badger Creek watershed at two data collection sites.

C. Distribution of Funds (CO-050-4340-5225):

Salaries	$ 7,400
Travel	1,900
Equipment	500
Computer	500
Laboratory	4,400
Total	$14,700

X. Flow and Water Quality Characteristics of Selected, Western Colorado Streams

Daniel Collins, WRD Project Chief (FTS 322-0302)

A. Location: The following three gaging stations will be operated to provide data necessary to define high- and low-flow characteristics of western Colorado streams:

a. 09118450--Cochetopa Creek below Rock Creek near Parlin, Colo.
b. 09123400--Lake Fork below Mill Gulch near Lake City, Colo.
c. 09060950--Big Alkali Creek below Castle Creek near Burns, Colo.

Additionally, BLM employees will collect water samples at selected, miscellaneous sites for submission to the U.S. Geological Survey Central Laboratory.

B. Objectives: Each gaging station contains a water-stage recorder to measure stream stage which is related to discharge measurements to develop a stage-discharge relationship. Periodic current meter or indirect measurements are made to check for deviations in the stage-discharge relationship. Stream-stage record coupled with the stage-discharge relationship is used to compute the following flow characteristics: minimum daily, maximum daily, annual peak discharge, and mean daily. These characteristics if available for a period of above- and below-normal climatic (precipitation) conditions can be used to describe recurrence frequencies of low- and high-flow events as well as the streams flow-duration characteristics. Additionally, a water-quality data base will begin to be established for streams sampled by BLM personnel and samples submitted for analyses by the USGS Central Laboratory.

C. Report Products: Copies of tabulated data will be provided to BLM and records will be published anually in "Water Resources Data for Colorado."

D. Distribution of Funds:

1. Object Class:

Salaries		$ 8,540
Travel		770
Equipment (includes rental)		1,520
Computer		120
Laboratory		10,000
	Total	$20,950

2. Work Element

Gaging Stations (3 @ $3,650)		$10,950
Laboratory		10,000
	Total	$20,950

XI. Oil Shale Hydrologic Investigations

Bob Tobin, WRD Project Chief (Comm. 303-878-5086)

A. Objectives: To assist in the definition of the hydrologic system of the Piceance basin including Piceance, Yellow, Roan, and Parachute Creeks. Key elements of the program include collection of hydrologic data to (1) define the interrelation of surface water flow, ground water movement into and from the alluvium, and precipitation as the control on ground water recharge and surface runoff; and (2) evaluate areal and temporal variations in water quality conditions and suspended sediment yield. The availability and quality of surface and ground water will be defined. Information will be available to evaluate impacts of future mining operations on the existing basin hydrologic systems.

For FY 82, limited funds available within the U.S. Geological Survey for oil shale studies are being used to analyze data and prepare reports. Therefore, the hydrologic monitoring program necessary to quantify and define quality of the surface and ground water systems will be discontinued unless another funding source is identified. Predevelopment data were collected at most sites in the early to middle 1970's. It is particularly important to continue hydrologic monitoring to determine system response time and quantity and quality variations associated with mine development activities including mine dewatering and surface clearing. As a means to this end, the following hydrologic program elements are identified for FY 82 BLM support.

B. Study Watersheds

1. Piceance Creek Basin: Discharge monitoring (at one site) and water quality and suspended sediment sampling (at two sites) will be continued on Piceance Creek mainstem. Water quality samples will be analyzed for common, inorganic constituents and selected nutrients (8 per year), and trace metals and bacteria (two per year). Samples will be collected to represent a range in flow regime. Automatic sediment samplers are used to obtain low and high flow samples for analyses of suspended sediment concentrations. The concentrations and discharge records are combined to produce a daily record of suspended sediment discharge. Additionally, discharge monitoring will be maintained on Black Sulfur Creek.

Precipitation and snowpack information is available at selected sites in the Piceance Creek basin. Data collection and compilation at these gages and snow courses are a part of continuing U.S. Geological Survey projects.

Distribution of funds is as follows:

a. Object Class:

Salaries	$15,760
Travel and vehicles	2,000
Equipment	1,500
Computer	700
Laboratory	9,800
Total	$29,760

b. Work Elements

Station Name	SW O&M	CQ O&M	Sediment O&M	Sediment O&M	CQ Lab (8/yr)	CQ Lab (2/yr)	PS-69	Total
Piceance Crk. blw. Ryan Gulch	Coop	2,080	4,000	2,000	2,080	820	Yes	$10,980
Piceance Crk. at White River	3,900	2,080	4,000	2,000	2,080	820	Yes	14,880
Black Sulfur Crk. nr. Rio Blanco	3,900	---	---	---	---	---	No	3,900
							Total	$ 29,760

2. Roan/Parachute Creek Basins: Discharge monitoring, water quality and suspended sediment sampling will be continued at two stations. Water quality samples will be analyzed for common, inorganic constituents and selected nutrients (8 per year) and trace metals and bacteria (2 per year). Samples will be collected to represent a range in flow to provide a daily sediment discharge record at Parachute Creek at Parachute; whereas, miscellaneous samples will be obtained to define variations with flow at Dry Fork near DeBeque.

Precipitation, snowpack, and climatic information is available at selected sites in the basin. These stations are maintained under ongoing Geological Survey projects.

Distribution of funds for the monitoring stations is as follows:

a. Object Class

Salaries	$13,960
Travel and vehicles	1,800
Equipment	950
Computer	450
Laboratory	8,400
Total	$25,560

b. Work Elements

Station Name	SW O&M	CQ O&M	Sediment O&M	Sediment O&M	CQ Lab (8/yr)	CQ Lab (2/yr)	PS-69	Total
Parachute Creek at Parachute	3,900	2,080	4,000	2,000	2,080	820	Yes	$14,880
Dry Fork nr. De Beque	3,900	2,080	1,200	600	2,080	820	No	10,680
							Total	$ 25,560

3. Potentiometric-Surface Mapping, Piceance and Yellow Creek Basins (CO-061): Aquifer dewatering resulting from oil shale mining will alter the existing steady-state conditions of the ground water system. The existing steady-state conditions need to be known prior to the beginning of oil shale mining so the effects of aquifer dewatering on the ground water system and ground water supplies can be determined.

Specifically, data from this project will be used to determine the predevelopment potentiometric surfaces for the two bedrock aquifers in the basin. With USGS funds, an interim report will be prepared interpreting existing condtions based on water-level data and aquifer test data acquired under the Survey's aquifer testing project.

Without continued data collection, potential impacts of mine dewatering on ground water supplies and lfows in Piceance Creek cannot be identified. Input dta for future ground water modeling efforts will also be substantially reduced. BLM funding will be used to provide continuity in the hydrologic data collection program at 60 wells. Measurements will be made semiannually at 60 sites, monthly at 10 and continuous record obtained at 2 wells. Information will be entered into the USGS WATSTORE system. Funding distribution is as follows:

Salaries	$ 9,380
Travel and vehicles	1,000
Equipment	800
Computer	500
Total	$11,680

4. Hydraulic Studies of Springs, Piceance and Yellow Creek Basins and Assistance in Hydrology Section Preparation for Prototype EIS: Financial support will be provided to supplement Geological Survey funds that are being used to compile and analyze data and prepare a report that describes what is known about the spring system and ground water quality in the Piceance basin. Additionally, USGS will support BLM hydrologists in their EIS work with data retrievals, summaries, and insight into most relevant componenets of the hydrologic system and potential interrelationships.

The information and assistance received from the Survey will be used by BLM hydrologists to prepare a prototype EIS for oil shale development. Funding distribution for the preceeding activities is as follows:

Salary	$11,300
Travel and vehicles	1,200
Computer	2,500
	$15,000

5. Effects of Energy Production Emissions on Lakes (Acidic Precipitation Study): Current and proposed production of energy in Colorado and surrounding States will release acidic gases and other constituents that can affect the chemistry of precipitation and of poorly buffered water in lakes and streams. The lakes and streams in the Flat Tops Wilderness Area in western Colorado are located downwind from areas of oil shale development and coal-burning power plants. The chemically unreactive geologic formations of the area, combined with orographic effect on precipitation, may cause the area to be particularly susceptible to the adverse effects of acid rain. Data on precipitation and lake quality do not exist to define predevelopment conditions.

Supplemental funding of $17,000 from BLM will be used to provide continuation of the station to collect wetfall-dryfall samples and wind direction information in western Colorado near Marvine Ranch, east of Meeker. Samples will be analyzed for nutrients, common ions, and selected trace metals. Ultimately, precipitation input information will be coupled with chemical quality information of local water resources, including lakes in the Flat Top Wilderness area, to assess impacts which result from mixing of different water types. Support of the precipitation quality results in the following distribution of funds:

Salaries	$ 7,100
Travel and per diem	950
Equipment	1,600
Laboratory	7,000
Computer	350
Total	$17,000

C. Report Products:

1. Components 1 and 2: Tabulated data can be provided to BLM and records will be published annually in "Water Resources Data for Colorado."

2. Component 3: Data from the ground water network will be entered into the USGS WATSTORE system and will be available to BLM for use in hydrologic investigations required for EIS preparation.

3. Component 4: The USGS plans to have a draft report available in late FY 82, which describes the springs network and general ground water quality conditions in the Piceance Basin. The report will be published as an open-file release. Additionally, USGS hydrologists will assist BLM hydrologists in preparing the hydrology section of the oil shale EIS. Assistance will be in the form of data retrievals, computer-generated summaries, and description of hydrologic systems.

4. Component 5: A preliminary report describing baseline lake quality conditions is planned for FY 82. Tabulated precipitation quality data from the Marvine Ranch station will be provided to the BLM upon completion of all chemical analyses for the water year.

D. Program Summary:

Component 1:	$29,760
Component 2:	25,560
Component 3:	11,680
Component 4:	15,000
Component 5:	17,000
Total	$99,000

Supplemental funding of $17,000 [illegible] used to complete continuation of the wharton to collect wetfall-drytfall samples and [illegible] direction [illegible] in Western Colorado near [illegible], [illegible]. Samples will be analyzed for [illegible], [illegible] selected trace metals. Ultimate [illegible] precipitation input information will be [illegible] with [illegible] quality information of local water resources, including [illegible] the Flat Top Wilderness area, to detect impacts which result from mining of different water [illegible]. Support of the precipitation quality results in the following distribution of funds:

[illegible]	$ 7,100
[illegible]	350
[illegible]	1,600
[illegible]	7,000
[illegible]	350
Total	$17,000

[illegible]

[illegible] data can be provided to BLM [illegible] be published [illegible] in "Water Resources [illegible]".

[illegible] the ground water network will be [illegible] system and will be available [illegible] investigations required for [illegible].

[illegible] to have a draft report available [illegible] describes the springs network and [illegible] conditions in the Piceance [illegible] published as an open-file [illegible]. [illegible] hydrologists will assist BLM [illegible] the hydrology section of the oil [illegible] will be in the form of data retrieval, [illegible] summaries, and description of [illegible].

[illegible] report describing baseline lake [illegible] is planned for FY 81. Tabulated [illegible] quality data from the Mayview Ranch station [illegible] to the [illegible] compilation of all chemical [illegible].

Idaho

IDAHO

SUMMARY OF FUNDS
WATER RESOURCES DIVISION

Project	CMP	Other (4340)
O & M Gaging Stations		
Herd Creek (13297597)		
Lolo Creek (13339500)	---	$ 8,560
O & M Gaging Stations		
*Saw Mill Creek		3,420
Bruneau River (13186500)		4,280
North Fork Big Lost River (1312000)		4,280
Lower Cedar Creek (13128900)		4,280
O & M ground water observation wells		5,000
	Total	$ 29,820

Total for the State of Idaho: $29,820

*New station, no station number assigned.

IDAHO

Robert O. Buffington, BLM State Director (FTS 554-1401)
Karl Gebhardt, BLM Technical Investigations Coordinator (FTS 554-1484)
Ernest F. Hubbard, Jr., WRD District Chief (FTS 554-1750)

I. Operation and Maintenance of Four Gaging Stations

Herman A. Ray, WRD Project Chief (FTS 554-1750)

A. Location

1. Herd Creek
2. Lolo Creek
3. Saw Mill Creek
4. Bruneau River near Hot Springs
5. North Fork Big Lost River
6. Lower Cedar Creek

B. Data Collection: Began January 1980 and to continue for a five-year period.

C. Reports: To be published in the USGS "Water Resources Data for Idaho."

D. Funding (ID-930-4340-5273):

Five stations @ 4,280	$21,400
Two stations @ 1,710	3,420
Observation wells	5,000
Total:	$29,820

Montana

MONTANA

SUMMARY OF FUNDS
WATER RESOURCES DIVISION

PROJECT	CMP
Hydrologic Characterization	
A. Streamflow and Surface Water Quality	$ 47,340
B. Ground-Water Levels	16,660
CMP Site Studies	129,000
Salinity Modeling of Rosebud and Armells Creek and Tongue River	16,000
Runoff Characteristics	17,000
Stream-Response Modeling	86,000
Aquifer Characteristics and Mine Spoils Research	66,000
Total:	$378,000

Total for State of Montana: $378,000

MONTANA

Michael J. Penfold, BLM State Director (FTS 585-6462)
Mike Whittington, BLM Technical Investigations Coordinator (FTS 585-6474)
George M. Pike, WRD District Chief (FTS 585-5302)

I. Hydrologic Characterization of Southeastern Montana Coal Areas

A. Network Maintenance of Stream-Discharge and Water-Quality Monitoring Sites

George M. Pike and J. Roger Knapton, WRD Project Chiefs (FTS 585-5263)

1. Objectives: Collect streamflow and water-quality data at key locations to supplement other programs. The data is essential in defining runoff from potential impact areas, determining streamflow characteristics, and providing a data base from which future changes can be analyzed.

2. Procedure: Standard U.S. Geological Survey methods of surface-water and water-quality data collection will be used to obtain data at the following stations:

Streamflow

Beaver Creek near Wibaux
Hanging Woman Creek near Birney
Otter Creek near Ashland

Surface-Water Quality
(*includes specific conductance)

Armell's Creek near Forsyth*
Rosebud Creek near Colstrip*
Rosebud Creek at Mouth near Rosebud*
Tongue River at Tongue River Dam, near Decker*
Pumpkin Creek near Miles City*

3. Report Products: Basic records from streamflow and surface- and water-quality sites will be submitted to BLM annually or as mutually agreed upon. Records will be published by the USGS in an annual report, "Water Resources Data for Montana." The data will be used by the USGS in preparing interpretive reports described in other parts of the work plan.

4. Relationship to Other USGS Studies: This program will supplement and be correlated with other USGS programs of streamflow and surface- and water-quality data collection. Other stations operated in this area include:

Rosebud Creek at reservation boundary at Kirby
Redwater River at Circle
O'Fallon Creek near Ismay
Redwater Creek near Vida
Mizpah Creek near Mizpah
Nelson Creek near Van Norman
Prairie Elk Creek near Oswego
Squirrel Creek near Decker
Burns Creek near Savage
Half Breed Creek near Roundup
Sarpy Creek near Hysham

5. Distribution of Funds:

Salaries	$ 23,670
Lab Services	7,200
Travel	8,170
Supplies	2,200
Data Processing	6,100
Total	$ 47,340

B. Ground-Water Monitoring

Thomas E. Reed, WRD Project Chief (FTS 585-5263)

1. Location: Fort Union coal region of eastern Montana.

2. Objectives: To provide ground-water data base from which an assessment can be made of the resource, future responses to stresses can be predicted, and pollution and supply problems can be detected and defined. This activity provides for long-term collection of ground-water data from selected observation wells. Specifically, wells monitored in CMP study sites are incorporated in this program to extend periods of data collection. In addition, selected holes drilled by industry or other agencies are cased and tested.

3. Procedures

a. Make water-level measurements and continue operation of water-level recorders.

b. Compile and analyze data.

c. Collect ground-water samples from selected wells.

d. Analyze water samples.

e. Case and test selected exploration holes drilled by industry or other agencies.

4. Report Products: Data collected under this program will be incorporated in CMP Site Study reports and in regional evaluations. The data will be stored in automated data files for rapid retrieval.

5. Relationship to Other USGS Studies: Data collected under this activity will be used to help define premining conditions of reclamation study sites, help calibrate ground-water models to predict the effects of mining, and help transfer data to surrounding areas from intensively studied reclamation sites.

6. Distribution of Funds:

Salaries for Data Collection		$ 8,160
Laboratory Services		500
Travel		4,000
Data Processing		2,000
Casing		2,000
	Total	$16,660

II. Hydrologic Site Studies

Neal E. McClymonds and Michael R. Cannon, WRD Project Chiefs (FTS 585-5263)

A. Locations: During FY 82, hydrologic studies begun in West Otter, Horse, Little Bear, Sand (Glendive), Miller-Greenleaf and Timber (Circle West) Creeks will be completed. Preliminary analysis of new study sites will be conducted to determine data needs at other mutually agreed-upon sites.

B. Objectives: To collect and evaluate hydrologic data at potential coal-lease area sites for activity planning in the Powder River and Fort Union coal regions. The studies are designed to compile available hydrologic information, design and implement site-specific data collection programs, coordinate data collection activities with other agencies and private companies, and evaluate the potential hydrologic impacts of mining and reclamation.

C. Procedures: Available hydrologic data will be compiled and evaluated. Data collection networks will be designed and implemented to acquire information.

D. Report Products: A report summarizing the hydrologic data and presenting the interpretations of hydrologic conditions in each site will be prepared. In most cases, a USGS Water Resources Investigation Report would be the intended publication media, but BLM-CMP reports may be used as the publication release.

E. Distribution of Funds:

Salaries	
Data Collection	$ 32,000
Data Analysis	73,000
Travel	12,000
Computer	6,000
Laboratory	5,000
Equipment	1,000
Total:	$129,000

III. Salinity Modeling of Rosebud and Armells Creek

Paul F. Woods, WRD Project Chief (FTS 585-5263)

A. Location: Rosebud and Armells Creek

B. Objectives: To construct and calibrate a digital model of Rosebud and Armells Creek which will simulate the salinity of the creeks through and downstream from existing and proposed mines. The model would be useful in simulating salinity in the creeks under various conditions of flow and development. This model would provide a tool for evaluating cumulative, off-site effects of various mine operations.

C. Procedures: A salinity model has been developed for use on the Tongue River. Data collection will be designed and implemented to obtain the necessary input information to apply the model to the creeks. Ground-water quality conditions, tributary quantity and quality, evapotranspiration, irrigation diversion, and return flow will be used to calibrate the model and simulate flow and quality in the creeks. When the model has been calibrated, various development scenarios will be simulated.

D. Report Products: A final report, summarizing the investigation findings, will be prepared for release in the USGS Water Resources Investigations series, will outline the modeling techniques used, and will present the simulation runs performed.

E. Relationship to Other USGS Studies: This program will bring together the results of several previous and ongoing studies, including runoff monitoring, surface-water quality monitoring, ground-water surface-water interrelation studies, and runoff modeling activities. Coal Hydrology funds from the USGS will supplement this project with $30,000.

F. Distribution of Funds:

Salaries	
Data Collection	$ 2,500
Data Analysis	10,000
Travel	500
Computer	3,000
Total	$16,000

IV. Surface-Water Flow Analysis

Robert J. Omang, WRD Project Chief (FTS 585-5263)

A. Location: Coal areas in eastern Montana.

B. Objectives: To develop techniques for estimating streamflow characteristics at ungaged sites in eastern Montana. To conduct studies in selected high priority coal lease sites to estimate runoff, peak flows, and flood boundaries.

C. Procedures: Prediction equations relating mean annual flow and flood stage-frequency data to various drainage basin parameters will be developed using standard multiple-regression techniques. An attempt to relate various measures of annual flow variability and flow distribution (e.g., standard deviation of annual flows and mean monthly flows) to drainage basin parameters will be made. To ensure that prediction equations will be as accurate as possible, new drainage basin parameters such as a soil index and some quantitative index of surface geology will be investigated. In addition, various statistical methods for extending the relatively short mean annual flow records will be considered, and a regional mean annual runoff map will be developed.

At selected high priority coal lease sites, the best available techniques will be used to determine mean annual flow, flow variability, and flood flows for various recurrence intervals. Channel geometry prediction equations, basin parameter prediction equations, nearby gage data, and regional runoff maps will all be considered in selecting the most applicable method in each case. Flood boundaries will also be determined at specified sites using regional flood stage-frequency data and the best scale available topographic maps.

D. Report Products: Streamflow characteristics determined for specific sites will be included as part of CMP site studies. For some areas, flood-prone area maps may be prepared for open-file release. A report describing the development of prediction equations for mean annual flow using basin parameters will be prepared in FY 82. A report documenting the development of prediction equations for flood stage for various recurrence intervals will also be prepared in FY 82.

E. Relationship to Other USGS Studies: This project is closely related to stream gaging networks including benchmark stations, short-term monitoring stations, miscellaneous sites, and crest-stage gages. The results of channel geometry work and the rainfall-runoff modeling projects will be used in estimating runoff at ungaged sites. The USGS coal hydrology program will supplement this project with about $32,500.

F. Distribution of Funds:

Salaries	
Data Collection	$ 6,000
Data Analysis	8,000
Travel	1,500
Computer	1,500
Total	$17,000

V. Hydrologic Modeling

Lawrence E. Cary, WRD Project Chief (FTS-585-6113)

A. Location: Prairie Dog Creek watershed in southeastern Rosebud County has been selected as the study site.

B. Objectives: The USGS has developed rainfall-runoff models which accurately predict runoff from storm events in some environments. However, the models have been developed for use in geologic and climatic conditions quite different from the prairie environment of Montana's coal region. The USGS is attempting to modify existing models to be responsive to the climatic and geologic conditions which prevail in eastern Montana. The Montana District, in conjunction with other WRD districts and Regional research hydrologists, will pursue problems related to runoff from snowmelt and for rainfall on frozen ground and other situations more appropriate to the Northern Plains region. Hopefully, the modified model can be calibrated for the Prairie Dog Creek watershed to verify its suitability for this area. If successful, the model will be extremely useful in evaluating the effects of land-use changes such as strip mining or reclamation on runoff from small drainages.

C. Procedures: The Prairie Dog Creek watershed has been instrumented with climatological and soil-moisture monitoring equipment to determine various parameters for modeling. Precipitation gages have been installed, soil-moisture access tubes have been emplaced, soil-temperature probes have been planted, stream gaging stations have been constructed, and monitoring of various parameters has begun. Data are being processed and modeling has begun.

D. Report Products: Data collected as part of this study will be extremely valuable to researchers in other agencies and to universities. To make this data useful to others, a series of basic data reports is planned to release climatological, soil, and streamflow data. A basic data report, containing hydrologic, meteorologic, and soils data for the 1981 water year, will be released in about March 1982. An open-file report describing the application of the flow model in Prairie Dog Creek watershed will be available for review in December, 1981. A report describing regionalization of model parameters will be released about June 1982. If an acceptable mined area can be identified, a report describing the application of the model to mined areas will be started in FY 82. A journal article describing the use of soil-moisture data to determine infiltration rates is planned for the first quarter of FY 82.

E. Relationship to Other USGS Studies: This project complements other programs in the Montana District. One currently troublesome aspect of rainfall-runoff modeling, for example, is the relationship of streamflow to ground-water systems. Work on the ground-water aspects of the study area being funded under another project will be extremely useful in evaluating the relationship of infiltration and ground-water discharge to streamflow. Several other WRD districts are involved in modifying existing runoff models to simulate various climatic, geographic, and geologic settings. Montana's work will be closely coordinated with these districts to minimize duplication, exchange information, and share experience and equipment.

F. Distribution of Funds:

Salaries	$67,000
Travel	6,000
Computer Costs	10,000
Laboratory	2,500
Equipment	500
Total	$ 86,000

VI. Grant to Montana Bureau of Mines and Geology for Hydrologic Investigations in High Priority Lease Areas and Investigations of the Soluble Salts in Coal Overburden and the Qualities of Ground Waters in Spoils

Robert E. Davis, WRD Project Chief (FTS 585-5263)

A. Location: Bull Mountains, Big Sky, Decker, and Colstrip areas.

B. Objectives: The objectives of hydrologic investigations of high priority lease areas are to acquire data needed to assess the potential impacts of mining on the hydrology of the areas. The objective of the soluble salts study is to develop techniques for predicting probable ground-water quality resulting from surface mining of coal.

C. Procedures: After initially evaluating existing data, locations where additional information is needed will be selected. Where needed, test holes will be drilled, eased and tested. Other hydrologic information to be collected includes water samples, water levels, and aquifer parameters. Additional research wells will be installed in spoils at the Decker, Rosebud, and Big Sky mines. Following installation, the wells will be tested by pumping to determine hydraulic conductivity values and to obtain samples for quality analysis. Selected wells will be equipped with continuous water-level recorders. Some will be re-tested periodically to determine transmissivity and water-quality changes that occur due to changes in saturated thickness. Compaction due to saturation occurs continuously in the spoils and will be examined periodically through use of refraction-seismograph techniques to determine effects on spoil transmissivity and water quality at selected research wells.

Overburden and spoils samples will be collected by coring and grab-sampling and will be submitted for laboratory leaching and paste-extract analyses.

Water-level and water-quality data will be added to the computer file for statistical and trend analyses. Determination of salts available for dissolution from overburden materials will be made from chemical analyses of water-saturated paste extracts of core samples. In addition to the suite of cations routinely run in these analyses, determinations of sulfate concentrations will be made; chloride can be assumed insignificant, so bicarbonate content will be estimated by subtraction. Column-leach tests will be conducted on some of the materials, and chemical analyses of the leachates will be used to validate the extract chemistry. For the saturated pastes and leach tests, both distilled water and site-collected ground and surface waters will be used. During the leach tests, leachate quality will be carefully monitored to define rates of salt removal. Type curves will be generated for dissolution rates to characterize hypothetical rates of salt removal from mine spoils.

D. Report Products: Formal reports on each study site will be prepared which describe the hydrologic features and identifies potential impacts and mitigating measures. Montana Bureau of Mines and Geology will submit the report to USGS for distribution to BLM. Annual progress reports for the soluble salts study will describe activities and results after each of the first 2 years. At the end of the third year, a final report will summarize the research and will include a recommended technique for predicting spoil-water quality. Additional communications during the project period will probably also be necessary to provide input to off-site transport models being developed by other researchers.

E. Relationship to Other USGS Studies: This program supplements the CMP site studies of the USGS and increases the number of tracts that can be completed each year. The soluble salts work will provide information needed by the USGS to develop geochemical models of mined areas.

F. Distribution of Funds:

Grant to Montana Bureau of Mines and Geology	$ 66,000

Nevada

NEVADA

SUMMARY OF FUNDS
WATER RESOURCES DIVISION

Project	CMP	Other (4340)
Floodplain Evaluation	---	$ 50,000
Saval Hydrology Studies	---	12,000
Total		$ 62,000

Total for the State of Nevada: $ 62,000

NEVADA WORK PLAN OUTLINE
USGS WATER RESOURCES DIVISION

Edward F. Spang, BLM State Director (FTS 470-5451)
Dick Jewell, BLM State Office Hydrologist (FTS 470-5455)
Timothy J. Durbin, WRD District Chief (com 702-882-1388)

I. Flood Hazard Evaluation

Otto Moosburner, WRD Project Chief (com 702-882-1388)

A. Location: Great Basin Region, Nevada

B. Introduction: The BLM is inventorying the natural resources of that part of the public lands that they administer, which is in response to a directive from the U.S. Congress. As part of the inventory, the BLM plans to delineate areas having flood-related hazards. They have asked the USGS for assistance with methodology for the delineation of flood-hazard areas in the Great Basin.

C. Objectives

1. Appraise the merits of the different methods for their possible uses in delineating flood-hazard areas in BLM lands in the Great Basin.

2. Make recommendations on which methods are preferred in delineating flood-hazard areas in mountains, in alluvial fans and valleys, and in playas.

3. Present guidelines, mainly by samples, on the use of the suggested different methods.

D. Approach: The study plan for the proposed project consists of two parts: (1) an overview of flood-related hazards and analytical procedures, and (2) technical procedures and approaches, summary, and recommendations.

Priority tasks for Part 1 are:

1. Describe the scope of problems as to: hydrologic and hydraulic setting, geographic limits, political subdivisions, geomorphic regimes (mountains, alluvial fans and valleys, and playas).

2. Compile reports and data.

3. Review published data and reports on flood hydrology and related subjects. Compile bibliography.

4. Schedule meeting with "flood specialists" and others in Western States to discuss the problem and explore approaches.

5. Prepare report summarizing Part 1.

The study may be terminated or significantly altered after Part 1 if the results of the overview indicate that the state of the art will not allow for the development of adequate technical procedures and approaches.

Priority tasks for Part 2 are:

1. Present regional discharge-frequency and depth-frequency studies for the Great Basin. This will require the development of regression equations for T-year discharges and depths.

2. Describe procedures that are recommended for mountainous areas, which will include discussions concerned with flood-frequency analyses, procedures for determining flood-carrying capacities of channels, methods used to determine water-surface profiles, and depth and velocity aspects of the problem.

3. Describe procedures that are recommended for predominantly alluvial fan areas. Included will be discussions concerned with flood-frequency analyses, attenuation away from mountainous areas, flood-carrying capacity of streams, water-surface profiles, space variability of flows, and depth and velocity aspects of the study.

4. Describe procedures that are recommended for playa areas, which will include discussions concerned with volume-stage and flood-frequency relations.

5. Describe assumptions, limitations, and uncertainities for the recommended different methodologies.

6. Discuss recommended techniques with BLM personnel.

E. Reports and Due Dates: Part 2 Status Report is due September 30, 1982.

F. Distribution of Funds (NV-930-4340-5225):

Salaries	$ 44,500
Vehicle	500
Travel	3,000
Computer	2,000
Total	$ 50,000

II. Saval Hydrology Studies

Steve Loomis, BLM Project Chief (FTS 234-2374)

A. Location: Saval Research and Evaluation Project, Elko County, Nevada

B. Objective: Hydrologic and water-quality baseline determination for Upper Gance Creek near Tuscarora (S.N. 10317450) and Upper Mahala Creek near Tuscarora (S.N. 10317420).

C. Procedures:

1. Data Collection:

   a. Daily discharges
   b. Peak discharges
   c. Water temperature (periodic)
   d. Dissolved oxygen (periodic)
   e. pH (periodic)
   f. Specific conductance (periodic)
   g. Total sediment
   h. Low flow

2. Data Reduction/Analysis: USGS District Office routine procedures.

3. Data Reporting: Basic water data reporting for Nevada, WRD.

D. Relationship to Other Studies: The resulting data will be used for calibration of the USGS rainfall-runoff model, under development with a separate Central Region CMP research project, p. 102 of this workplan.

E. Distribution of Funds (YA-450-4340-5225)

Operation and Maintenance	$11,000
Sediment (4 Stations)	1,000
Total	$12,000

New Mexico

Attachment A.
Sampling Frequency and Water-Quality Parameters
for Surface-Water Stations.

Frequency	Schedule Name	Parameters	Phase
Semiannually	Major constituents, add boron	Ca, Mg, Na, K, Cl, F, SiO_2, SO_4 alkalinity, ROE, & B	Dissolved
"	Iron, manganese	Fe & Mn	Dissolved and total
"	Suspended sediment	Suspended-sediment concentration and percent finer than 62.5 microns	Suspended
Five flow events captured by sets of single stage samplers positioned at low, medium, high, and flood stages at each ephemeral site	Single-stage samples	Suspended sediment including complete size distribution (annually)	Total (sample captured by single-stage samplers)
Semiannually for perennial sites and for ephemeral sites	Drinking water toxic trace elements and trace elements associated with coal (by atomic absorption)	As, Ba, Cd, Cr, Pb, Hg, Se, Li, & Sr	Dissolved and total
Annually	Radiochemical	Gross alpha, gross beta, uranium, & radium	Dissolved and suspended
"	Bottom material trace metals	As, Ba, Be, Cd, Cr, Co, Cu, Pb, Mn, Hg, Mo, Ni, Se, & Zn	Bottom material

NEW MEXICO

SUMMARY OF FUNDS
WATER RESOURCES DIVISION

San Juan Coal Region

Project	CMP Funding Total
Watershed Characterization	$20,800
Hydrologic Surveillance	84,100
Hydrologic Modeling-Kimbeto	67,100
Hydrologic Modeling - Regional Groundwater Impacts	68,000
Totals	$240,000

Total for the State of New Mexico: $240,000

USGS WATER RESOURCES DIVISION
WORK PLAN OUTLINE
NEW MEXICO - FEDERAL COAL MANAGEMENT PROGRAM
WORK PLAN PROPOSAL FOR FY 1982

Charles W. Luscher, BLM State Director (FTS 476-1217)
Herb Garn, BLM Technical Investigations Coordinator (FTS 476-1227)
James F. Daniel, WRD District Chief (FTS 474-2246)

I. Watershed Characterization

Bob Hejl, WRD Project Chief (FTS 474-6506)

A. Location: Coal-lease areas in San Juan, Sandoval, and McKinley Counties located in northwestern New Mexico.

B. Introduction: The BLM needs methods to estimate quantity and quality of runoff from small ungaged drainage areas to evaluate water resources in planning studies.

C. Objectives: To provide BLM with a method to estimate quantity and quality of runoff from small ungaged drainage areas in northwestern New Mexico.

D. Approach: The data to develop relationships to estimate streamflow and water-quality characteristics from watershed parameters in the coal-lease areas is continually being compiled and analyzed. The data being collected for gaged small watersheds, most of which have short periods of streamflow and water-quality records, include channel-geometry measurements, streambed material particle-size distribution, channel slope, infiltration rate of watershed and vegetative cover. Other data being compiled for each of the watersheds include drainage area, mean annual precipitation, watershed slope, and basin shape. Regression techniques are used to develop methods for predicting streamflow and water-quality characteristics from channel geometry and watershed characteristics.

E. Report Products and Due Dates: A report defining parameters for estimating selected streamflow characteristics will be completed in September 1982, which will be based on additional data and will include more parameters than the 1981 report.

F. Relationship to Other Studies: This study was closely coordinated with a regional watershed characterization study of strippable coal areas in the central and western United States. This study differs from the regional study in that it is specific to the coal-lease areas in northwestern New Mexico. The objectives of the regional study are: (1) to

test the transferability of existing streamflow-basin characteristic relationships to coal-lease areas; (2) to develop new relationships for streamflow characteristics to measurable dimensions of channel geometry and basin characteristics for ephemeral streams; and (3) to develop similar relationships for estimating sediment transport characteristics and other water-quality transport characteristics for perennial and ephemeral streams.

G. Progress: Report published --
Hejl, H. R., Jr., Preliminary appraisal of ephemeral streamflow characteristics as related to drainage area, active channel width and soils in northwestern New Mexico: U.S. Geological Survey Open-File Report 81-64, 23 p.

H. Distribution of Funds:

Salaries	$19,400
Laboratory Services	0
Travel	800
Data Processing	600
Total	$20,800

II. Hydrologic Surveillance of Coal-Lease Areas

Bob Hejl, WRD Project Chief (FTS 474-6506)

A. Location: Coal-lease areas of San Juan and McKinley Counties located in northwestern New Mexico.

Streamflow (Continuous Record) and Water-Quality Sites

Papers Wash near Star Lake
(Sec. 12, T. 19 N., R. 6 W.)

Chaco Wash near Star Lake
(Sec. 25, T. 20 N., R. 7 W.)

De-na-zin Wash near Bisti Trading Post
(Sec. 14, T. 23 N., R. 13 W.)

Hunter Wash at Bisti Trading Post
(Sec. 13, T. 23 N., R. 13 W.)

Ground-Water Observation

Bisti West Reclamation Study Site
(7 wells; T. 23 N., R. 12 W.)

Kimbeto Reclamation Study Site
(10 wells; T. 22 N., R. 9-10 W.)

Ojo Encino Reclamation Study Site
(5 wells; T. 19-20 N., R. 5 W.)

B. Introduction: Prior to 1975, virtually no water resources information was available in the coal-lease areas in northwestern New Mexico. The technical investigation (formerely EMRIA) program began in New Mexico in FY 1975 to assure adequate baseline water resources data would be available for choosing reclamation goals and establishing lease stipulations for surface mining for coal.

C. Objectives: To (1) document hydrologic characteristics of streamflow and ground water in coal-lease areas and their variabilities in quantity and quality and (2) predict the effects of coal extraction and associated development on the water resources in northwestern New Mexico. This information will aid BLM in their operations pertaining to coal-lease stipulations and land management practices of multiple purpose uses of the public domain.

D. Approach: Established basic data collection sites will be continued for collecting adequate water resources data under natural or present conditions to establish a baseline as to quantity and quality from which to predict the effects of surface extraction of coal and related activities. Some of the areas at or near the gaged sites will be mined in the future which will enable us to compare the measured effects of surface mining for coal on the water resources to the predicted effects.

Each of the four established continuous record streamflow data collection sites has a set of three to four single-stage samplers for collecting water-quality samples at low, medium, high and flood stages. Two sites which are of limited use to BLM's technical investigations were exchanged for two sites in BLM's Chaco PRLA planning unit. Those two sites were previously in USGS' Coal Monitoring Network. Two of the sites are also equipped with an automatic pump sampler.

We will continue to collect and analyze for a comprehensive suite of water-quality parameters at least semiannually at the gaged streams. The comprehensive suite of parameters will include major inorganic constituents, trace elements, radiochemical parameters (annually), and suspended-sediment data.

Water-quality parameters such as specific conductance, pH, suspended-sediment concentration and dissolved oxygen will be measured on additional samples because of their usefulness as index water-quality parameters. Samples will be collected by field personnel if the site is found flowing, by single-stage samplers, or by automatic pump samplers (see Attachment A).

The 22 established ground-water data collections sites are completed either in the overburden, in the coal seams, or in the Pictured Cliffs sandstone underlying the coal seam. We will measure water levels annually.

E. Report Products: All data collected in the Federal Coal Management Program will be published by the USGS in the annual basic data report, "Water Resources Data for New Mexico." Water resources information that has been collected in the Federal Coal Management Program and other programs in the strippable coal areas will be analyzed to aid BLM in management decisions of coal-lease areas of the public domain in the interim, prior to the release of comprehensive formal reports such as water-supply papers. Preliminary information on transfer techniques and interpretations of flow systems will be the subject of these studies. The subjects of these studies will be determined through close collaboration with BLM personnel. Proposed reports are:

1. Water-quality characteristics of surface-water resources in strippable coal areas in northwestern New Mexico, May 1983.

2. Characteristics and chemical quality of shallow water-bearing units in the strippable coal areas in northwestern New Mexico, November 1982.

F. Relationship to Other Studies: The hydrologic surveillance effort is coordinated with 15 streamflow gaging sites, 25 surface-water quality sites, 15 observation-well sites (water level and water quality), supported with USGS Federal coal hydrology funding, and four streamflow and water-quality sites funded by the National Park Service. Most of the sites were established October 1977. Interpretation of hydrology and techniques to transfer data to ungaged drainage basin in coal-lease areas of northwestern New Mexico for BLM-CMP reports will make use of all data available from all projects in the project area.

G. Distribution of Funds:

Salaries	$45,500
Laboratory Services	8,700
Travel	2,000
Equipment and Supplies	3,900
Operation and Maintenance of Existing Gages	20,200
Data Processing	3,800
Total	$ 84,100

III. Hydrologic Modeling-Kimbeto Reclamation Study Site

Bob Hejl, WRD Project Chief (FTS 474-6506)

A. Location: The modeling control basin with drainage area of 8.2 mi is located within BLM's Kimbeto Reclamation Study Area in northwestern New Mexico.

B. Introduction: Initially (1975) the Federal Coal Management Program was directed to obtaining baseline water-resources information. In 1977, Congress passed the Surface Mining Control and Reclamation Act (Public Law 95-87). This act specifically addressed hydrologic impacts of surface mining, i.e., the mine plan would have to show how the hydrologic balance of the mine area would be restored to premine conditions before a plan could be approved. The Federal land manager must be certain reclamation criteria goals can be met. A drainage basin was instrumented in 1978 to collect data for the development of a predictive precipitation-runoff model.

C. Objectives: The objectives are to develop, calibrate, and verify precipitation-runoff models for predicting surface runoff characteristics and sediment yield under various land-use conditions in the coal-lease areas in northwestern New Mexico. The emphasis will be on relating parameters used by the model to measurable physical features of a selected watershed basin to facilitate transferability of the model from an instrumented basin to uninstrumented basins.

D. Approach: A watershed (Ah-shi-sle-pah Wash) with a drainage area of 8.2 square miles in the strippable coal-lease area in the San Juan Basin is instrumented to collect data for the development, testing, calibration, and verification of precipitation-runoff models. The instrumentation includes a streamflow gaging station, an automatic pump sampler, single-stage samplers, meteorological station, and five recording rain gages located for equal area distribution over the basin (T. 22 N., R. 10 W.) and two rain gages outside the basin to define regional rainfall intensities and frequencies. Collection of water-quality data from reclaimed spoil piles at three sites at the San Juan mine (T. 30 N., R. 15 W.) and three sites at the Navajo mine (T. 29 N., R. 15 W.) will be continued.

Data collection and analyses for model development will be continued to define basin soil properties, soil-water storage characteristics, soil detachability, vegetation characteristics, and topography. Data will be tested in the basic model developed by the Regional Precipitation-Runoff Modeling Project as it is being collected. Data testing during the collection period will aid in refinement of data collection techniques.

E. Report Products: An interim report will be prepared in 1982, when enough data will be available for an initial calibration of the model, as additional data are collected and the model is improved and verified.

F. Relationship to Other Studies: This program is closely coordinated with the Regional Precipitation-Runoff Modeling Group in Lakewood, Colorado. The modeling group in Lakewood is developing a basic model to be used in coal-lease areas.

G. Distribution of Funds:

Salaries	$39,200
Laboratory Services	3,000
Travel	1,200
Equipment and Supplies	500
Operation and Maintenance of Existing Gages	15,100
Data Processing and Model Calibration	8,100
Total	$67,100

IV. Hydrologic Modeling - Regional Ground-Water Impacts

A. Introduction: The U.S. Bureau of Land Management (BLM) is preparing environmental impact analyses for the development of coal on public-owned land in the San Juan Basin. Ground water is, or soon will be, needed for coal processing, possible coal slurry pipe lines, coal gasification, drilling, petroleum reservoir pressurization, and power generation.

There is considerable concern about the possibility of adverse effects in aquifers at existing supply wells, as well as the future availability of ground water.

Recognizing the key role of ground water in coal development, the BLM has requested that the U.S. Geological Survey, Water Resources Division, assist in evaluating the cumulative impacts of ground water withdrawals on the water resources of the basin.

B. Location: The area of the ground water model includes the San Juan Structural Basin in northwestern New Mexico and southwestern Colorado as outlined by outcrops of Jurassic-age rocks. In the vertical dimension, the model includes rocks of Jurassic and Cretaceous age, including the Entrada Sandstone, part of the Lewis Shale and the intervening units.

C. Objective: The principal objective of this study is to make an engineering estimate of the long-term water-level changes in the principal ground-water units (except for the Tertiary-aged units) and changes in the flow to the San Juan River. These predictions will be for current withdrawals and for probable future withdrawals related to "all" development in the area,

including that from activities not directly associated with proposed BLM actions. BLM will include this information in their coal lease environmental impact statements.

D. Procedure: The finte-difference, steady-state model of Frenzel and Lyford (1981), will be used in a manner similar to Wilson's (1977) model simulation of a complex Florida aquifer system. The values and distribution of hydraulic conductivity will be changed to reflect more recent aquifer test results if they become availble.

However, no field work is foreseen for this project. Plausible values and distributions of storage coefficients will be inserted into the model. The recharge and discharge boundaries will be altered from those of Frenzel and Lyford (1981) and utilized in this stress-type model. Water withdrawal rates, sites, and formations will be furnished by BLM project personnel. Due to the scope of the project and the lack of historic data, no effort to calibrate the model is foreseen. Extensive but not exhaustive sensitivity testing will be done. The computer program of Posson and others (1980) as modified to run on the Cray computer will also be utilized.

In short, the plan is to produce the projections desired by BLM using the knowledge, facilities, and personnel that are readily availale in the Albuquerque Office.

E. Report Products: The structure of the model, assumptions, and predictions will be described in a report that will be released to the open-file on or before October 1, 1982.

F. Relationship to Other USGS Studies: This study complements the Watershed Characterization, Hydrologic Surveillance and Hydrologic Modeling-Kimbeto studies because they are concerned with surface effects of mining and geologic units that are, for the most part, hydraulically close to the coal. The major emphasis of this study, on the other hand, involves aquifers that, for the most part, are associated with the coal only as potential water supplies for development. This study is mainly expedient due to the present needs of BLM. It parallels two other current ground water studies: 1) "Crownpoint Surveillance" of which the objective is to begin a program of collecting more time-dependent data and 2) "Ground-water effects" of which the objectives are to a) continue collecting time-dependent data and b) create, using that data, a transient-state model.

G. Distribution of Funds:

Salaries		$44,000
Computer Costs		20,000
Miscellaneous		4,000
	Total	$68,000

North Dakota

NORTH DAKOTA

SUMMARY OF FUNDS
WATER RESOURCES DIVISION

Site-Specific Hydrologic Investigations	CMP FUNDS
Rattlesnake Butte Area, Dickinson Deposit	$ 16,000
SE Williams County Deposit	30,000
McKenzie County Ground-Water Reconnaissance Study	40,000
Hydrologic Modeling, Fort Union Coal Region; Beach-Wibaux and Antelope Creek	80,000
Airborne Snow Surveys	20,000
Total	$186,000

Total for the State of North Dakota: $186,000

NORTH DAKOTA

Michael J. Penfold, BLM Montana State Director (FTS 585-6462)
Mike Whittington, BLM Technical Investigations Coordinator (FTS 585-6474)
Grady L. Moore, WRD District Chief (FTS 783-4601)

I. Site Specific Hydrologic Investigations

William F. Horak, Jr., Project Chief (FTS 783-4607)

A. Rattlesnake Butte

William F. Horak, Jr., Project Chief (FTS 783-4607)

1. Objectives: In response to the Interior Department's recent call for leasing nominations of Federal coal lands, most eligible tracts within the Dickinson deposit were submitted by mining concerns for consideration of their leasing potential. The interest manifest in the Dickinson field indicates a possibility of future development, of which the Rattlesnake Butte area is a part. This study is an investigation to evaluate the probable hydrologic impacts of that potential development in an area of interest to BLM. Depending on the hydraulic properties and the areal continuity of the lignite and adjacent aquifers, many of these water sources could be diminished or obliterated.

   Of particular significance to the city of Dickinson would be the effects on the Heart and Green Rivers. The Heart River is located one mile west of Dickinson and serves as the city's water supply reservoir. The Bureau of Reclamation is currently studying the feasibility of creating a water supply reservoir on the Green River, anticipating future shortage.

   The primary objectives include assessing the ground-water flow system and its chemical characteristics and determining surface-water flow magnitudes and frequencies, chemical quality, and sediment concentration and load.

   By defining the hydrologic regime of the study area, a further objective will be satisfied--establishing a historical data base to monitor changes in the system as mining proceeds. The ultimate objective is to develop the capability of making reasonably accurate projections of the hydrologic effects which result from the various physical treatments imposed by surface mining. Management agencies would then be able to utilize this predictive tool to augment their decision-making processes.

2. Approach: Such operational components of the total hydrologic regime as infiltration and percolation, evaptranspiration, changes in storage in the unsaturated zone, and the various modes of exchange between shallow subsurface and surface-water systems, will be quantitatively assessed. This will allow for appropriate perspective placement of each component in the overall system. One of the early project emphases will be program implementation. Also emphasized will be effecting the instrumentation necessary to quantify all hydrologic cycle segments and pathways and to discern the nature of and the mechanisms operative on its water quality.

   Collected data will be used to gain a thorough knowledge of the hydrologic system. Quantitative hydrologic parameters will be refined and data deficiencies will be identified. The additional data will be obtained and estimates made of the hydrologic effects of various land treatments within the study area.

3. Relationship to Other Closely Associated Non-CMP Funded Activities: The Dickinson deposit is one of the deposits that will be covered by the hydrologic reconnaissance studies under ND-070F, which was started in FY 75 and is funded by the U.S. Geological Survey. The data collection under ND-070F will be of value to the present study. Since the ultimate objective of ND-070F is to provide an in-depth appraisal of the hydrologic effects of mining for each of the identified strippable deposits, the Rattlesnake Butte study will result in a savings in the eventual overall cost of ND-070F.

   Data on streamflow, sediment loads, quality of water, and ground-water levels are being collected in the study vicinity. These data are being collected through programs with the North Dakota State Water Commission, Environmental Protection Agency, Corps of Engineers, and USGS funds. There will be a mutually beneficial exchange of data between the programs.

4. Progress Through 1981: The second of two drilling programs was completed in 1980. A total of about 30 test holes have been drilled to an average depth of 350 feet. The geohydrologic environment was found to vary markedly across the study area. Observation wells were installed in aquifers where encountered. A sand section in the lower part of the Sentinel Butte Member occurs persistently across the central part of the study area and was tapped with several observation well completions. The commercial lignite bed underlies the eastern third of the study area and observation wells were installed in it where the lignite was saturated.

Continuous record-gaging stations have been in operation on the two major streams draining the study area since fall '77 and fall '78, respectively. The streams are characterized by relatively high springtime flows derived from snowmelt, intermittent discharge peaks following summer thunderstorm activity, and sustained baseflow of very minor magnitude during the rest of the year.

All existing observation wells have been sampled for chemical analysis. Samples are taken at the gaging stations at least twice annually and at miscellaneous locations during the fall baseflow period.

Geologic and hydrologic data acquired from the drilling programs are being compiled and interpreted. Structure, thickness, and potentiometric-surface maps have been constructed for the major aquifers. Single well response tests are being conducted to determine aquifer transmissivities. If feasible, these data will be utilized in a digital flow model of the shallow ground-water system. If not, qualitative interpretations of the effects of surface mining on the hydrologic system will be drawn.

The collection of monthly water-level data from all observation wells and of continuous discharge data from the two gaging stations will continue through FY 81. Final interpretations have been made and the report is in early preparation and will be completed in early FY 82.

5. Distribution of Funds:

Salaries	$15,500
Data Processing, including computer costs	500
Total	$16,000

6. Reports: Basic records for surface-water quantity and surface-water quality stations will be published in the USGS annual series, "Water Resources Data for North Dakota, Water Year 1982," or as an appendix to an interpretive report. Basic records for ground-water levels and ground-water quality stations will be available to BLM and other interested parties and as an appendix to the interpretive report. The interpretive report on the hydrologic evaluation of the Rattlesnake Butte area is scheduled for review by July 31, 1982, and will probably be published in the Water Resources Investigation series of the USGS.

B. M and M Deposit, Southeast Williams County

Robert L. Klausing, WRD Project Chief (FTS 783-4607)

1. Objectives: The study area consists of about 230 sq mi in southeastern Williams County. It includes five drainage basins underlain by four potential strippable lignite beds. The drainage basins are tributary to Lake Sakakawea, which forms the southern boundary of the area. The eastern boundary of the study area conforms to the eastern limit of the Dry Creek drainage basin and the northern boundary conforms to the northern limit of the Beaver Creek drainage basin. The western boundary is formed by the western limits of Beaver, Nelson, and Tobacco Garden Creek drainage basins.

   At the present time there are no mining activities in the study area, nor are any expected within the next few years. Consequently, mining impacts will not be observable during the life of this study. All hydrologic observations will be of the premining or natural condition. The effects of coal development on the system will have to be extrapolated from small-scale tests or experiments and(or) simulated with the aid of appropriate models. The primary objective will be to define the hydrologic regime in the greatest possible detail consistent with the project duration and funding. This will include assessment of the ground-water flow system and its chemical characteristics, determination of flow magnitudes and frequencies, chemical quality, and sediment concentration and load. By defining the hydrologic regime of the study area, a second objective will be obtained--the establishment of a historical data base which will make it possible to monitor changes in the system as mining proceeds. The ultimate objective is to at least qualititatively project the hydrologic effects resulting from the various physical treatments imposed by surface mining.

2. Approach: Existing geologic and hydrologic data and reports relating to the study area will be assembled to serve as a source of information. Additional data required to meet the objectives of the study will be outlined as completely as possible at this initial state. To gain information of the water usage in the area, a local well inventory will be conducted. Well depths, water levels, pumpage rates, and general water-quality information at each site may give an indication of current and potential water-supply problems.

An observation well network will be established to obtain water-level and ground-water-quality data for the major shallow aquifers in the area. All test holes will be logged geophysically. Some coring will be done to obtain samples of various lithologies for hydrologic and geochemical analysis. Most of the test holes will be screened and cased as observation wells.

Miscellaneous stream gaging will be done at selected points on the streams to provide flow information. The streams will be sampled on a flow magnitude basis for water quality analysis. These data will provide a historical record of premining conditions. The water quality data, for both surface and ground waters, will establish the utility of the water for various uses and should give some indication of the geochemical influences operational within the undisturbed flow system.

Sediment samples will be collected periodically to establish baseline conditons for sediment concentrations and loads in selected streams of the study area.

3. Relationship to Other Closely Associated Non-CMP Funded Activities: The M and M deposit is one of the deposits covered by the hydrologic reconnaissance studies under ND-070F, which was started in FY 75, was scheduled for completion in FY 77, and was funded by the USGS. The deposit is covered by the County Ground-Water Resources study of Williams County completed in 1969. This study was funded under a cooperative agreement by the USGS, the North Dakota State Water Commission, and the North Dakota Geological Survey.

   Data on streamflow, sediment loads, quality of water, and ground-water levels are being collected in the vicinity of the study. These data are being collected through programs with the North Dakota State Water Commission and with USGS funds. There will be a mutually beneficial exchange of data between the programs.

4. Progress Through 1981: The literature search has essentially been completed. Drill-hole data relative to coal resources and ground-water hydrology were obtained from the literature and commercial sources. These data were used to prepare a bedrock topography map, structure contours on some of the lignite beds, and a drift thickness map. These maps were useful in determining test-hole sites.

A ground-water monitoring program was established January 1981 using observation wells installed by the USGS and Chevron Resources Company. There are presently 21 wells in the program. Fifteen of the wells are developed in the Ray aquifer. Water-level data from these wells were used to prepare a preliminary potentiometric surface map for the Ray aquifer.

A well inventory of private wells in the area was completed. Data obtained from the inventory consist of well depths, water levels, pumpage rates, and aquifer type. Values of specific conductance and pH of the water from private wells are obtained to determine the general water quality.

The test drilling to determine the limits of the Ray aquifer and the shallower lignite deposit aquifers was completed. Footage drilled was about 6,300 feet. Approximately 36 test holes were drilled and observation wells were installed at most of the sites. Two or more observation wells were installed at some sites. Water samples were collected from the wells to determine chemical quality. Hydraulic conductivity values will be obtained for the major aquifers.

Streamflow and quality of water data are being collected for the major streams in the area.

5. Distribution of Funds:

Salaries	$20,000
Travel	7,000
Laboratory Costs	2,500
Contractual Services	100
Equipment and Supplies	300
Data processing, including computer costs	100
Total:	$ 30,000

6. Reports: Basic records for surface-water quantity and surface-water quality stations will be published in the USGS annual series, "Water Resources Data for North Dakota, Water Year 1982," or as an appendix to an interpretive report. Basic records for ground-water levels and ground-water quality stations will be available to BLM and other interested parties and as an appendix to the interpretive report. The interpretive report on the hydrologic evaluation of the M and M deposit area is scheduled for review by April 1982 and will probably be published in the Water Resources Investigation series of the USGS.

II. Reconnaissance Studies

A. Investigation of the Ground-Water Resources of McKenzie County, North Dakota

Mack G. Croft, WRD Project Chief (FTS 783-4607)

1. Objectives: McKenzie County contains large deposits of federally owned lignite and is potentially one of the major lignite-producing counties of the State. Much of the lignite is saturated and in fact is the host rock for aquifers that supply water for domestic and farm use in much of the county. In view of its mining potential and the importance of ground-water supplies to the residents, it is important that ground-water information be obtained prior to mining so that the probable effects of mining may be predicted and so that land reclamation after mining be undertaken to reconstruct the aquifer systems.

   The purpose of this study is to survey and document the quantity, quality, and movement of ground water in McKenzie County. In addition, this study will provide fundamental data and quantitative interpretations on which water-management decisions can be made for municipal, domestic, industrial, and irrigation uses. Specific objectives are to: (1) determine the location, extent, and nature of major aquifers, including estimates of storage and potential yield; (2) evaluate the chemical quality of the ground water; (3) identify current and potential use of ground water; (4) estimate and attempt to quantify the movement of ground water, including sources of recharge and discharge, and (5) define at a reconnaissance level, the relationship between the near-surface hydrology and the coal deposits.

2. Approach: This is a relatively comprehensive study of the ground-water resources. Study methods are categorized by the following activities: (1) project planning, (2) water records, (3) test drilling, (4) chemical quality of water sampling and analyses, (5) aquifer tests and special studies, (6) data compilation and analysis, and (7) report preparation.

3. Relationship to Other Closely Associated Non-CMP Funded Activities: This study is jointly funded through CMP funds, USGS, U.S. Park Service, North Dakota State Water Commission, and North Dakota Geological Survey. There are no other funded projects in the county at this time.

4. Progress Through 1981: A well inventory of the county is in progress with selected water samples obtained for chemical analysis. In 1980, three Fox Hills wells were drilled in a cross section across the county. About 30 wells were drilled in glacial-drift aquifers to define water quality and yield for irrigation and municipal purposes. In the summer of 1981, 10 Tongue River wells and four Tullock wells will be drilled to further define these aquifers. Also 20 or 30 additional glacial-drift wells will be drilled to fill in gaps in these aquifers. About 150 water samples have been analyzed from the aquifers.

5. Distribution of Funds:

Salaries	$ 7,000
Travel	1,500
Contractual Services	30,000
Laboratory Costs	1,000
Data Processing	500
Total:	$40,000

6. Reports: Three reports will be published cooperatively by the North Dakota State Water Commission and the North Dakota Geological Survey. Part I will describe the surface geology; Part II will be a compilation of basic data, including data on existing wells and test holes; and Part III will be an interpretative report describing and evaluating the ground-water resources of the county. The final reports are scheduled for completion by September 30, 1982.

III. Hydrologic Modeling

Douglas G. Emerson, WRD Project Chief (FTS 783-4607)

A. Surface-Water Modeling, Fort Union Coal Region

1. Objectives: This project is a part of two broader scoped studies--"Hydrologic effects of mining and reclamation, Mercer County" and "Hydrologic effects of mining and reclamation, Wibaux-Beach lignite deposit"--which are scheduled to end September 1979 and September 1980, respectively. The modeling of the ground-water system will be complete by these dates, but the modeling of the surface-water system cannot be completed due to the lack of a sufficient data base. The surface-water modeling will need at least five years of data.

Preliminary data indicate that the proposed expansion of strip-mining activities in the Beulah area may result in streamflow regimen changes. Although there are currently no mining activities in the Wibaux-Beach area, coal mining is expected in the future with probable attendant changes. Some changes will be temporary, but others will remain even after strip mining has ceased. The purpose of this investigation is to provide a means for BLM personnel or others to judge the impacts of changing land use. The objectives are to: (1) determine premining hydrologic conditions in small representative drainage basins, (2) provide historical data to compare the magnitude of change with mining, and (3) develop the capability of making reasonably accurate projections of hydrologic effects resulting from the various land treatments imposed by surface mining.

2. Approach: This will be a comprehensive study of two small representative basins. Surface models will be developed through coupling of snowmelt- and rainfall-runoff models. A distribution-parameter approach will be used in the model by having the basin partitioned into subunits based on slope, vegetation type, soil type, snow distribution, and other factors.

3. Relationship to Other Closely Associated Non-CMP Funded Activities: The proposed study will be funded jointly through CMP funds and USGS Federal funds. The Wibaux-Beach and Beulah trench lignite deposits are two of the deposits covered by the hydrologic reconnaissance studies under ND-070F, which was started in FY 75, was scheduled for completion in FY 77, is in the report stage, and is funded by the USGS.

   Data on streamflow, sediment loads, quality of water, and ground-water levels are being collected in the vicinity of the studies. These data are being collected through programs with the North Dakota State Water Commission and with USGS funds. There will be a mutually beneficial exchange of data between the programs.

4. Progress Through 1981: Data collection and analysis continued as schedule with the surface-water data from the regular stream-gaging stations being published in the annual report, "USGS Water Resources Data for North Dakota, Water Year 1982."

   The report "Progress Report on the Effects of Surface Mining on the Surface-Water Hydrology of Selected Basins in the Fort Union Coal Region, North Dakota and Montana," has been published. The report describes the data collection activities, status of the modeling efforts, and a brief evaluation of the critical hydrologic processes of the two basins.

The report "Data Report for the Surface-Water Hydrologic Investigations of the Hay Creek Study Area, Montana, and the West Branch Antelope Creek Study Area, North Dakota, 1977-1980 Water Years" has been prepared. It is a compilation of the data collected during 1977-1980 water years for the surface-water hydrologic investigations in the two study areas.

A draft of an analysis report has been written. Major emphasis in the report is on analyzing the critical periods. From the conclusions of this report, the data collection and modeling efforts can be focused on the critical periods that affect the surface-water hydrology in the study areas.

Some model runs have been made, but with the results of the analysis report and another year of data, more complex model runs will be made. Model modification will be made to compensate for the special problems and critical periods associated with the two study areas.

5. Distribution of Funds:

Salaries	$ 64,500
Travel	10,000
Contractual Services	1,000
Supplies and Equipment	--
Laboratory Costs	2,000
Data Processing, including computer costs	2,500
Total	$ 80,000

6. Reports: The runoff, chemical quality, and sediment data will be published annually in the series, "Water Resources Data for North Dakota, Water Year 1982." The final report is planned at the end of approximately five years of data collection, assuming a sufficient data base will be available to answer the objectives. The report will probably be published in the series, "Water-Resources Investigations," or some type of open-file report. The model will be retained on diskettes and/or disk for future use. Progress reports will be furnished periodically as needed.

Table 1. NORTH DAKOTA. LIST OF WATER-QUALITY PARAMETERS.

Hydrologic Studies	
Field	
Discharge (ft^3/s)	SW only
Temperature (°C)	
pH	
Specific conductance	
Laboratory	
Alkalinity (Total as $CaCO_3$)	
Boron, Diss	
Calcium, Diss	
Chloride, Diss	
Fluoride, Diss	
Hardness, Noncarb	
Hardness, Total	
Iron, Diss	
Magnesium, Diss	
Manganese, Diss	
Molybdenum, Diss	
Nitrogen, Diss KJD	SW only
Potassium, diss	
Residue, Calc Sum	
Residue, Diss Ton/Aft	SW only
Residue, Diss Ton/Day	SW only
SAR	
Silica, Diss	
Sodium, Diss	
Sodium, Percent	
Strontium, Diss	
Sulphate, Diss	
Susp. Sed. Conc.	

IV. Special Studies

Douglas G. Emerson, WRD Project Chief (FTS 783-4607)

A. Airborne Snow Surveys

1. Objectives: Due to accompanying winds of varying intensities and directions, snow occurring over the northern Great Plains does not distribute uniformly. As the sophistication of snowmelt and runoff models increases, the need for accurate, timely snow-cover information also grows. Regardless of watershed size, an effective model requires a really distributed snow-cover depth and water-equivalent data. The latter provides knowledge of the stored water volumes available for runoff, while a measure of snow thickness indicates the expected rate of melt- and channel-water movement.

   The present snow survey methods are inadequate in the Great Plains environment without a cost-prohibitive manpower requirement.

   The objectives of the study are: (1) to investigate the possibilities of combining airborne snow survey and landscape-stratified sampling techniques to determine snow water equivalents at selected landscape units; (2) to compare snow-cover densities for selected land-use types (stubble, fallow, brush, etc.) as determined by airborne and ground snow surveys, with the anticipation that snow-cover density could be monitored remotely from aircraft, leaving snow-depth measurements for rapid ground-based collection; and (3) to evaluate the error associated in passing a gamma radiation scintillation counter (NAI) rapidly over snow covers differing in depth, water equivalent, and slope position such as evidenced on steep slopes of prairie ravines and large coulees.

2. Approach: Two methods of making snow surveys will be used to obtain the objectives of the study. The first is a ground snow survey using a terrain type land-use method as outlined by Steppuhn and Dyck (1974). Pastures, cultivated fields, sloughs, brush, etc., within the same climatic region tend to accumulate snow according to recurring patterns unique to specific terrain type and land use. Therefore, snow samples collected within similar areal units result in a statistically valid estimate of true snow water equivalents.

   The second method is an airborne snow survey system based on the attenuation of natural terrestrial gamma radiation due to snow cover. The operational program serves primarily National Weather Service River Forecast Centers in the

upper Midwest. The merits of a calibration flight line to accurately index the actual mean areal snow cover over the entire watershed will be examined.

3. Relationship to Other Closely Associated Non-CMP Funded Activities:

The study is funded jointly through CMP funds and USGS Federal funds with direct services contribution by the National Weather Service. The project will result in a mutually beneficial exchange of information with streamflow and snowmelt-runoff programs with the North Dakota State Water Commission and the Corps of Engineers and USGS.

4. Progress Through 1981: The flight lines have been established and the collection of the necessary background soil moisture for the airborne snow-survey part of the study has been completed. The study areas have been delineated into land use and terrain type for the ground snow survey part of the study. Due to the lack of snow this past winter, no snow data were obtained. Therefore, no data analysis could be made. All the preliminary work has been completed and we are waiting for the collection of snow data next winter.

5. Distribution of Funds:

Salaries	$16,000
Travel	3,000
Computer Costs	1,000
Total	$20,000

6. Reports:
Due to lack of data, the preliminary report that was planned for September 1981 was not written. The final report will be completed at the end of the study and depends on the duration of the investigation. The report probably will be published in the Water-Resources Investigations series or in some type of open-file report. Progress reports will be furnished periodically as needed.

Ohio

Ohio

OHIO

SUMMARY OF FUNDS
WATER RESOURCES DIVISION

Northern Appalachian Coal Region

Project	CMP Funding Total
Impact of Abandoned Mines on Stream Quality, Ohio	$23,000

Total for the State of Ohio: $23,000

OHIO

Roger L. Hildebeidel, BLM ESO Director (FTS 235-2833)
Jerry Coalgate, BLM Technical Investigations Coordinator (FTS 235-2868)
Steven M. Hindall, WRD District Chief (FTS 943-5258)

I. Impact of Abandoned Mines on Stream Quality, Ohio

Frank Giessner, WRD Project Chief (FTS 943-5861)

A. Location: The Yost II property in the Wayne National Forest in Hocking County near Haydenville, Ohio.

B. Background: Eastern Ohio contains many surface mines which were worked before effective reclamation laws. These mines were abandoned when mining ceased. Water-quality problems resulting from abandoned surface mines have been well documented. In general, stream water affected by abandoned surface mines has a low pH, excessive concentrations of sulfate, metals, and sediment, and supports few or no aquatic organisms. Such water is generally too corrosive and/or hard for industrial use, and too hard and/or toxic for agricultural or municipal use.

During the summer of 1981, the U.S. Geological Survey (USGS) installed a stream gage, a three-parameter water quality monitor, and an automatic sediment sampler at the Yost II site in Wayne National Forest, 13 miles northwest of Athens, Ohio. Pre-reclamation streamflow, water chemistry, and suspended samples were collected through FY 1981 with funding supplied by the Forest Service.

Although reclamation is recommended for current surface mining, little information is available on the effectiveness of reclamation on abandoned mines, especially those which are long abandoned. It is assumed that reclamation will provide a long-term solution to water quality problems and will restore thousands of acres of land in Ohio which are currently of very limited use. The degree to which this is true, despite variations in geology, topography, duration of abandonment, and reclamation methodology, is a matter of question. In addition, assuming that reclamation is successful, it is not known how long it takes for the hydrologic system to stabilize.

Because several State and Federal agencies plan to spend large amounts of money on reclamation projects, it is desirable to have more information on the long-term effectiveness of reclamation and both its progressive and ultimate impact on the hydrologic system.

C. Objectives

1. Collect flow data, water quality data, and sediment data before, during, and after the reclamation process at Yost II.

2. Compare the chemical quality before and after the reclamation stabilization.

3. Determine the species diversity of the benthic invertebrate population and describe the post-reclamation stream recovery of biological species.

4. Prepare an interpretive report describing the impact of the reclamation process on the hydrologic system.

D. Procedures: Prior to reclamation, water samples will be collected during low flow conditions and the samples will be analyzed for aluminum, iron, manganese, calcium and magnesium. Bottom material will be sampled for arsenic, cadmium, chromium, copper, iron, lead, manganese, mercury, and zinc. Benthic invertebrates will be sampled quantitatively. In addition, water-quality and sediment samples will be collected during 3 to 4 runoff events to establish prereclamation high-flow conditions.

During and after reclamation, monthly water samples will be collected and analyzed for the parameters in Table 1. Samples also will be collected and analyzed for those parameters during runoff events. Trace metals will be measured once after reclamation and biannually if results warrant. After reclamation, benthic invertebrates will be sampled quarterly, and bottom materials twice a year. Daily values for discharge, temperature, specific conductance, dissolved oxygen, and pH will be obtained from the gage and monitor. Sediment samples will be collected during runoff events by the Manning sampler and will also be collected manually to establish a rating factor. The data will be collected beginning May 1981 and continuing through May 1985.

E. Benefits: Information obtained from this study will advance the state-of-the-art of knowledge of the aquatic impacts of mining and reclamation practices. Specifically, it will result in a better understanding of the recovery process associated with the reclamation of disturbed areas resulting from surface and/or underground coal mining in the eastern United States. The information will be useful to other reclamation researchers, OSM regulatory personnel, and Ohio Department of Natural Resources reclamation specialists.

The U.S. Forest Service unit, Berea, Kentucky, will also soon monitor reclamation of a watershed near the Yost II area. A comparison of data from the Berea project with that from the USGS project would enhance the benefits mentioned above.

F. Report Products: A USGS Open-File Report containing a description of progress and preliminary data will be sent to the Regional Hydrologist by July 1983. A USGS Open-File Report of the full interpretive study will be sent to the Regional Hydrologist by December 1985.

G. Distribution of Funds:

Salaries	$15,400
Travel	600
Equipment	3,100
Laboratory	3,800
Computer	100
Total	$23,000

Oklahoma

OKLAHOMA

SUMMARY OF FUNDS
WATER RESOURCES DIVISION

Western Interior Coal Region

Project	Distribution of CMP Funds Total
Hydrologic Investigations:	
Blocker Area	$ 3,500
Rock Island Area	3,000
Red Oak Area	9,000
Stigler Area	3,500
Watershed Characteristics	50,000
Hydrologic Model: Coal Creek near Lehigh	49,000
Totals:	$118,000

Total for the State of Oklahoma: $118,000

OKLAHOMA

Roger L. Hildebeidel, BLM ESO Director (FTS 235-2833)
Malcolm Charleton, BLM Technical Investigations Coordinator (FTS 476-1227)
James H. Irwin, WRD District Chief (FTS 736-4256)

I. Introduction

A. Purpose and Scope: BLM is responsible for assessing the probable water resources impacts and reclamation capabilities of any area under Federal jurisdiction in which surface coal mining might occur. To meet this responsibility, a variety of hydrologic data is required. In Oklahoma, these datas are being provided by: (1) hydrologic monitoring in selected areas, and (2) hydrologic modeling of Coal Creek Basin near Lehigh. In addition, hydrologic data are also being generated by the Survey's monitoring program at 12 sites in the coal field and sediment data collection at these 12 sites under the auspices of the BLM.

Areas near Blocker, Rock Island, Red Oak, and Stigler have been identified as having high potential for mining of Federal coal. Hydrologic data collection in the Blocker and Rock Island areas began in 1976 and in the Red Oak and Stigler areas in 1978.

II. Hydrologic Investigations

Robert L. Tortorelli, WRD Project Chief (FTS 736-4256)

[The following section describes the hydrologic data collection program in effect from October 1, 1971 to January 25, 1982. At that time all data collection was discontinued.]

A. Blocker Area

1. Blue Creek near Blocker

   a. Continue surface-water gaging station.

   b. Collect samples as scheduled.

2. Blue Creek Tributary near Blocker: Make instantaneous discharge measurement at time samples are collected.

3. Mathuldy Creek near Crowder: Make instantaneous discharge measurement at time samples are collected.

4. Maintain ground-water level recorder near Blocker.

5. Maintain rain gage near Blocker.

6. Sample Frequency

   a. Monthly--Common constituents and nutrients.

   b. Semi-monthly--Field parameters, dissolved and total metals, and sediment.

   c. Semi-annually--Bottom materials.

7. Suites of Analyses--See Attachment A.

8. Reports

   a. Streamflow, stream-water quality, and sediment data will be published in the annual data report.

   b. A preliminary report on the hydrology of the Blocker area has been approved for publication.

B. Rock Island Area

1. James Fork near Hackett, AR: Collect samples as scheduled.

2. James Fork near Williams: Make instantaneous discharge measurement at time samples are collected.

3. Maintain ground-water level recorder.

4. Maintain rain gages near observation well.

5. Sample Frequency and Suites of Analyses: Same as for Blocker area.

6. Reports

   a. Streamflow, stream-water quality, and sediment data will be published in the annual data report.

   b. Complete report on the hydrology of the Rock Island area including all basic data collected as of September 30, 1979. The report will be submitted for approval by June 1982.

C. Red Oak Area

1. Brazil Creek near Walls below Mining Area

   a. Continue surface-water gaging station.

   b. Collect samples as scheduled.

2. Brazil Creek near Red Oak above Mining Area: Make instantaneous discharge measurement at time samples are collected.

3. Rock Creek near Red Oak above Mining Area: Make instantaneous discharge measurement at time samples are collected.

4. Jefferson Creek near Red Oak: Make instantaneous discharge measurements at time samples are collected.

5. Bear Creek near Red Oak: Make instantaneous discharge measurements at time samples are collected.

6. Maintain ground-water lever recorder.

7. Maintain rain gage.

8. Sample Frequency and Suites of Analyses: Same as for Blocker area.

9. Reports

   a. Streamflow, stream-water quality, and sediment data will be published in the annual data report.

   b. A preliminary report on the hydrology of the Red Oak area will be submitted for approval by June 1982.

D. Stigler Area

1. Taloka Creek near Stigler below Mining Area

   a. Continue surface-water gaging station.

   b. Collect samples as scheduled.

2. Taloka Creek near Stigler above Mining Area: Make instantaneous discharge measurement at time samples are collected.

3. Jackson Creek near Stigler: Make instantaneous discharge measurement at time samples are collected.

4. Maintain ground-water level recorder.

5. Maintain rain gage.

6. Sample Frequency and Suites of Analyses: Same as for Blocker area.

7. Reports

a. Streamflow, stream-water quality, and sediment data will be published in the annual data report.

b. A preliminary report on the hydrology for the Stigler area will be submitted for approval by June 1982.

E. Distribution of Funds:

Salaries	$ 12,600
Travel	3,800
Computer	-0-
Equipment	300
Laboratory	2,300
Total	$ 19,000

III. Watershed Characteristics

Robert L. Tortorelli, WRD Project Chief (FTS 736-4256)

[The following is a description of the data collection program in effect from October 1, 1981 until January 25, 1982. At that time data collection was discontinued.]

A. Data currently being collected plus supplementary stream-discharge and water-quality data from sites in five basins will be used to aid in transferring hydrologic models.

1. Blue Creek near Blocker - Two supplementary sites

2. Ti Creek near Blanco - One supplementary site.

3. Red Oak Creek near Red Oak - One supplementary site

4. Morris Creek at Howe - Two supplementary sites

5. Holi-Tuska Creek near Panama - No additional sites.

B. Water samples collected monthly at the above listed sites to determine:

1. Field parameters, sediment, and common constituents for low-flow conditions.

2. Field parameters, sediment, and common constituents for storm events by use of Manning samplers.

C. Maintain rain gages in each basin.

D. Complete assembly of published soils data for each basin.

E. Complete stream cross-section survey of each basin.

F. Make preliminary model calibration for each basin using three models.

1. USGS Rainfall-runoff model

2. SCS TR-20

3. Corps of Engineers HEC-1

G. Reports

1. Streamflow, water quality and sediment data will be published in the annual report.

2. Work on final report has begun and will continue until all available funds have been expended.

H. Distribution of Funds:

Salaries	$ 37,700
Travel	2,300
Computer	7,000
Equipment	500
Laboratory	2,500
Total	$ 50,000

IV. Hydrologic Modeling - Coal Creek Basin near Lehigh, Oklahoma

Stephen P. Blumer, WRD Project Chief (FTS 736-4256)

[The following is a description of the data collection program in effect from October 1, 1981 until January 25, 1982. At that time data collection was discontinued.]

A. Surface-Water Flow Regime

1. Coal Creek

a. Continue surface-water gaging station.

b. Continue crest stage gage.

2. Coal Creek Tributaries

a. Operate SR (stage-rainfall) gages.

b. Continue crest stage gages.

c. Make periodic discharge measurements.

B. Stream Water Quality

1. Coal Creek

a. Continue water-quality monitor for pH, specific conductance, dissolved oxygen, and temperature.

b. Continue automatic water sampler to collect suspended sediment samples daily and during runoff events.

c. Continue monthly water sample collection and during selected runoff events for analysis of common constituents and nutrients.

d. Collect approximately 20 water samples, divided between runoff events and baseflow, for metals analysis.

e. Collect water samples quarterly for organic carbon analysis.

2. Coal Creek Tributaries

a. Continue single-stage sediment samplers.

b. Continue water sample collection quarterly to determine field parameters, common constituents, nutrients, metals, and organic carbon.

C. Ground-Water Regime

1. Continue ground-water level recorder.

2. Make annual mass measurement of all accessible wells in the basin and selected wells outside the basin.

D. Climatological Data

1. Continue operating continuous climatological station to determine air temperature, relative humidity, solar radiation, precipitation, and wind speed and direction.

2. Continue operation of three additional precipitation gages.

3. Continue periodic soil moisture measurement at 12 sites.

E. Modeling: Continue rainfall-runoff model calibration and verification (both daily and unit models).

F. Reports

1. Streamflow, stream-water quality, and sediment data will be published in the annaul data report.

2. Work on a final report has begun and will continue until all availble funds have been expended.

G. Distribution of Funds:

Salaries	$ 42,000
Travel	1,600
Computer	1,500
Equipment	1,400
Laboratory	2,500
Total	$ 49,000

Attachment A.

Analytical Suites

Field Parameters

00400	pH
00095	Specific conductance
00010	Water temperature
00300	Dissolved oxygen
	Instantaneous water discharge

Common Constituents -- DISSOLVED

00955	Silica
00915	Calcium
00925	Magnesium
00930	Sodium
00935	Potassium
00410	Alkalinity
00940	Chloride
00945	Sulfate
00950	Fluoride
70300	ROE at 180° C
00800	Color
00076	Turbidity

Nutrients

	Dissolved	Total
Nitrogen, Kjeldahl	00623	00625
$NO_3 + NO_2$	00631	00630
Phosphorous	00666	00665

Metals

	Dissolved	Total
Aluminum	01106	00105
Arsenic	01000	01002
Boron	01020	01022
Cadmium	01025	01027
Chromium	01030	01034
Copper	01040	01042
Iron	01046	01045
Lead	01049	01051
Manganese	01056	01055
Mercury	71890	71900
Molybdenum	01060	01062
Zinc	01090	01092

Calculated Values

Sodium adsorption ratio (SAR)
Total hardness
Dissolved solids tons/acre feet

Bottom Materials

00626	Nitrogen, Kjeldahl
00633	$NO_3 + NO_2$
00668	Phosphorous
01108	Aluminum
01003	Arsenic
01028	Cadmium
01034	Chromium
01043	Copper
01170	Iron
01052	Lead
01053	Manganese
71921	Mercury
01063	Molybdenum
01093	Zinc

Utah

UTAH

SUMMARY OF FUNDS
WATER RESOURCES DIVISION

Unita-Southwestern Utah Coal Region

Project	Distribution of CMP Funds Total	Other (4340)
Hydrology of Kaiparowits, Alton, and Kolob coal fields (UT-146)	$134,000	
Floodplain mapping in BLM-administered lands in Utah (UT-148)	107,500	
Ground water conditions in the Trail Mountain Coal Resource Area (UT-152)	245,300	
Gaging station at the mouth of the White River, Uinta Basin (UT-1 and 4)	14,200	
Cooperative State programs (UT-1, 3, and 4)		57,100
Totals:	$501,000	$57,100

Total for State of Utah: $ 558,100

UTAH

Vacant, BLM State Director (FTS 588-5311)
Boyd Christensen, BLM Technical Investigations Coordinator (FTS 588-4033)
Ted Arnow, WRD District Chief (FTS 588-5663)

I. Hydrology of the Kaiparowits Plateau, Alton, and Kolob Coal Fields (UT-146)

Gerald Plantz, WRD Project Chief (FTS 588-5654)

A. Location: The Kaiparowits Plateau, Alton, and Kolob coal fields in southern Utah.

B. Objectives: To define the hydrologic system and, where possible, to identify or predict the effects of coal mining on the water resources.

C. Approach: During FY 82, work will concentrate on defining the quantity and quality of surface water and extent and characteristics of aquifers above, within, and directly below the coal-bearing rocks. Major work items include a well and spring inventory; an inventory of water use and discharges from mines; water sampling from selected wells and springs for chemical analyses; miscellaneous discharge measurements and water sampling to define seasonal variations in surface-water quality and to define losing and gaining reaches of streams; aquifer tests on existing wells.

D. Distribution of Funds:

Planning	$ 5,000
Data Collection	44,000
Data Processing and Analysis	19,000
Laboratory Support	12,000
Supplies and Equipment	2,000
Computer Services	500
Travel	8,000
Overhead (District and National Headquarters)	43,500
Total	$134,000

E. Report Products: The report for the study will be published in the Water-Supply Paper series and will be prepared by September 1983 in the Hydrologic Atlas.

II. Flood-Plain Mapping in BLM-Administered Lands in Utah (UT-148)

Kenneth L. Lindskov, WRD Project Chief (FTS 588-5654)

A. Location: Statewide, with emphasis on coal-lease areas.

B. Objectives: (1) Provide methods for outlining areas inundated by floods of selected frequencies, (2) describe the hydraulic and hydrologic factors that must be considered when preparing flood-plain maps, and (3) publish a report outlining procedures for flood-plain mapping including profiles of historic floods, profiles of theoretical floods, FIA studies, and "quick and dirty techniques."

C. Approach: Although much of the effort will be in evaluating existing data and methodology, new relations for estimating flood depths for selected return periods will be developed. The depths above median discharge for all sites with more than five years of record will be related to basin and climatic characteristics by multiple-regression techniques. In addition, recommendations will be given for when to use "quick and dirty techniques" versus more complicated ones based on accuracy and available manpower.

D. Funding: $107,500

E. Report Products: A Water-Supply Paper, which will essentially be a "manual" that can be used by BLM and other interested parties to determine areas that would be inundated by floods of different recurrence intervals. The report will contain a few representative flood maps and will be prepared by September 30, 1982.

III. Ground-Water Conditions in the Trail Mountain Coal-Resource Area, Central Utah (UT-152)

Gregory C. Lines, WRD Project Chief (FTS 588-5654)

A. Location: Trail Mountain in the Wasatch Plateau coal field, central Utah.

B. Objectives: (1) Determine aquifer characteristics, recharge-discharge relationships, hydraulic connection between aquifers and with streams, and chemical quality of water in water-bearing zones within, above, and immediately below the coal-bearing rocks in the Blackhawk Formation, (2) predict, quantitatively where possible, the effects of underground mining on the ground-water system, including discharge to streams.

C. Approach: Major work items include testing wells with expandable packers to determine head and water-quality differences with depth in the ground-water system; determinations of aquifer characteristics utilizing conventional aquifer tests and drill-stem tests; an extensive spring inventory to define points and volumes of ground-water discharge, chemical quality of ground water, and typical discharge recessions; baseflow measurements on streams to define losing and gaining reaches; and laboratory determinations of porosity and hydraulic conductivity of cores to define intrinsic characteristics of both aquifers and confining beds. A digital-computer model of the ground-water system will be constructed and calibrated. The unverified model will be used to make semiquantitative predictions of effects of mine dewatering on the ground-water system, including discharge along streams.

D. Distribution of Funds:

Well testing, plugging, and site reclamation	$ 150,000
Salaries	19,000
Per diem	2,200
Vehicles	3,000
Chemical analyses	2,000
Laboratory work on core samples	3,000
Computer	100
Overhead (District and National Headquarters)	66,000
Total	$ 245,300

E. Report Products: The interpretive report will be prepared by September 30, 1983 and will be released to the open file pending publication as a Water-Supply Paper.

IV. Gaging Station at the Mouth of the White River, Uinta Basin (UT-1 and 4)

Russell W. Cruff, WRD Project Chief (FTS 588-5663)

A. Location: Southeastern Uinta Basin; drainage area is about 2,400 sq mi.

B. Objective: To collect streamflow and sediment data in FY 1982; to continue depending on annual funding.

C. Approach:

1. Operate streamflow gaging station at one site:

09306900 White River at mouth, near Ouray, Utah, in SE1/4 SE1/4NW1/4 sec. 2, T. 9 S., R. 20 E., Uintah County, latitude 40°03'54", longitude 109°38'06".

2. Collect daily sediment samples at gaging site shown under item 1 and calculate daily suspended-sediment loads.

D. Distribution of Funds (UT-930-4340-5273):

Salaries	$ 3,900
Travel and transportation	1,550
Supplies and equipment	150
Laboratory support	3,200
Data processing and report	800
Overhead (District and National Headquarters)	4,600
Total	$14,200

E. Report Products: Information will be included in annual basic data reports. BLM may request data directly if needed.

V. Cooperative State Programs (UT-1, 3, and 4)

Russell W. Cruff, Project Chief (FTS 588-5663)

A. Objective: To determine the sediment, salinity, and discharge of water resources in the San Rafael River, Muddy River, and Sevier River drainages and in the Pariette Wash area, in Emery, Wayne, Sevier, and Uintah Counties, respectively (Utah).

B. Approach: Operate and maintain sediment, water quality, and gaging stations during FY 82.

C. Distribution of Funds (UT-930-4340-5273):

(Totals for UT-1, 3, and 4 = $57,100)

UT-1 Collection and basic records, surface water

Ferron Creek near mouth, near Clawson	$ 3,980
Muddy Creek, 3 miles above Salt Wash	3,980
San Rafael River, at San Rafael campground, near Castle Dale	3,980
Pariette Draw below Pleasant Valley Wash, near Myton	3,980
Pariette Draw at mouth, near Ouray	3,980
Lamb Diversion at Pariette Draw, near mouth	3,980
Cottonwood Creek near Orangeville	3,980
Otter Creek at Koosharem	3,980
Total	$31,840

UT-3 and 4 Collection of basic records, chemical quality, and sediment.

Ferron Creek near mouth, near Clawson	$ 3,600
Muddy Creek, 3 miles above Salt Wash	3,600
San Rafael River, at San Rafael campground, near Castle Dale	3,600
Pariette Draw below Pleasant Valley Wash, near Myton	3,600
Pariette Draw, 5 miles above mouth	3,600
Pariette Draw at mouth, near Ouray	3,660
Cottonwood Creek near Orangeville	3,600
Total	$25,260

D. Report Products: Information will be included in annual basic data reports. BLM may request data directly if needed.

West Virginia

WEST VIRGINIA

SUMMARY OF FUNDS
WATER RESOURCES DIVISION

Northern Applachian Region

Project	Distribution of CMP Funds Total
Hydrologic Modeling of Small Streams in the Coal Areas of Appalachia	$ 74,000

Total for the State of West Virginia: $ 74,000

WEST VIRGINIA

Roger Hildebeidel, BLM ESO Director (FTS 235-2833)
Jerry Coalgate, BLM Technical Investigations Coordinator (FTS 235-2868)
David H. Appel, WRD District Chief (FTS 924-1300)

I. Hydrologic Modeling

Celso Puente, WRD Project Chief (FTS 924-1300)

A. Location: Study sites are small basins (generally less than 10 mi^2) with similar topographic, geologic, and hydrologic settings, and varying land-use characterisitcs in and near coal areas in the Monongahela National Forest and other coal areas of West Virginia.

B. Objectives: To develop predictive methodology useful to BLM for describing the hydrologic system and for assessing the impacts of mining in ungaged areas under Federal mineral ownership in West Virginia and other coal-producing areas in Central Appalachia. The objectives are to:

1. Develop, calibrate, and verify deterministic rainfall-runoff models for simulating streamflow under various climatic and land-use conditions.

2. Develop water-quality regression models for estimating water-quality changes resulting from coal mining and for simulating chemical constituent concentrations and solute loads.

C. Procedures: Model development will be based on calibration of measurable climatic, hydrologic, and physical features to achieve acceptable synthetic streamflow. It will be useful for estimating soil-moisture storage relationships, infiltration, surface runoff, and ground-water/surface-water relationships. Model calibration and verification will be based on available data that ranges from 6 to 12 years in duration gathered from approximately 15 small basins monitored as part of other hydrologic studies in West Virginia. Model calibrations using data from streams draining basins under various phases of mining will permit an evaluation of basin system responses to basin changes imposed by changing land use. An evaluation will be made of changes in model parameters required to reproduce the physical processes of the changing hydrologic system. The application of the model to many widely distributed basins will provide an opportunity to demonstrate model parameter regionalization and transferability to other basins in Central Appalachia. The basins selected for modeling will represent the following land-use categories:

1. Active surface-mined areas, active underground-mined areas, and combination of surface- and underground-mined areas.

2. Old, abandoned, and unreclaimed mixed areas.

3. Reclaimed areas.

4. Undisturbed control areas.

An evaluation of water-quality data (major inorganic constituents and select trace elements) in the coal areas of West Virginia will be made to determine if regional water-quality regression models can be developed and added to the watershed model as a subroutine module.

D. Report Products: Study data is stored in USGS computer data files and is available to other agencies and organizations. An interim interpretive report presenting basic data and project results during FY 81 and 82 will be prepared by September 30, 1982. A final interpretive report covering all areas studied will be prepared at the conclusion of the study 1983 through 1984.

E. Relationship to Other USGS Studies: This project benefits from and supplements other programs in the West Virginia District. A current project (WD-152) consists of monitoring climatic and hydrologic data in mined and unmined basins in the Big Sandy-Tug Fork basins of Virginia, West Virginia, and Kentucky. These sites will provide test cases for demonstrating model applications and transferability to ungaged areas. Other similar studies in Indiana, Pennsylvania, Kentucky, Tennessee, and Alabama will benefit from mutual exchange of information between the programs.

F. Distribution of Funds:

Salaries	$62,200
Travel	5,000
Data Processing	4,800
Equipment and Supplies	2,000
Total	$74,000

Wyoming

WYOMING
DISTRIBUTION OF FY 82 CMP FUNDS

Water Resources Division

Project	CMP Total
I. Hydrologic Characterization: Surface Water, Water Quality and Sediment	$ 49,900
II. Precipitation, Infiltration and Runoff Relations	22,100
III. Streamflow Characteristics	22,000
IV. Potentionetric Maps of Shallow Aquifers	24,000
V. Recharge and Discharge through Alluvium of Ephemeral Stream Channels in Wyoming	45,000
VI. Lance-Foxhills and Wyodak Potentiometric Maps in the Powder River Basin, Wyoming	25,000
Total	$188,000

Total for State of Wyoming: $188,000

WYOMING

Maxwell T. Lieurance, BLM State Director (FTS 328-2326)
Cliff Franklin, BLM Technical Investigations Coordinator (FTS 328-2425)
William W. Dudley, Jr., WRD District Chief (FTS 328-2153)

I. Hydrologic Characterization--Streamflow, Water Quality, and Sediment

A. Locations: Powder River, Green River, Great Divide, Bear River, Hanna, Big Horn, and North Platte Basin.

B. Objectives: Determine runoff, chemical and biologic quality, and seidment-transport characteristics of streams in or near areas of extensive coal deposits.

C. Procedures: The operation of steramflow and water-quality stations, started in 1976, was discontinued on October 1, 1981. Funds for FY 1982 will be used for orderly closedown of the stations and to process the 1981 hydrologic records for computer storage and publication.

D. Report Products: All data collected have been or will be published in the USGS annual series of data reports. This information has been and will continue to be used in interpretive studies related to coal hydrology.

E. Distribution of Funds:

Salaries	$43,400
Travel	3,000
Laboratory	3,000
Computer	500
Total	$49,900

Distribution of Funds by Type:

SW	$ 25,800
QW	5,580
Sed	18,520
Total	$ 49,900

II. Precipitation, Infiltration, and Runoff Relations for Small Basins in Wyoming

James G. Rankl, WRD Project Chief (FTS 328-2153)

A. Location: Wyoming, statewide.

B. Objectives: Federal regulations regarding surface coal mining and reclamation specify that precipitation-frequency criteria be used for hydraulic design. Very little data are available to define the precipitation-runoff relation. This project is designed to develop methods for accurately estimating runoff volumes from small drainage basins for selected precipitation frequencies. Specifically, the objective is to define infiltration-rate curves for soil and other surficial material by an incipient ponding-curve method developed by Rankl (USGS).

C. Procedure: This incipient ponding curve will be expanded to cover a number of additional basins with differing soil characteristics so that the infiltration model will have wide application in Wyoming basins.

D. Report Products: The final report, which will be prepared in FY 82, will describe the methods, soil types, and the ponding equations. It will be published in the Water-Resources Investigation Series.

E. Distribution of Funds:

Salaries	$21,200
Travel	300
Computer	600
Total	$22,100

III. Streamflow Characteristics of Energy-Mineral Areas in Wyoming

Hugh W. Lowham, WRD Project Chief (FTS 328-2153)

A. Location: Wyoming, statewide.

B. Objectives: Information relative to streamflow in the energy areas of Wyoming is inadequate for proper planning, designing, and monitoring of the effects of energy-resource development. Data for developing predictive techniques have been particularly scarce for small intermittent and ephemeral basins. Yet, most existing or proposed mines in Wyoming occur in small basins that have only intermittent or ephemeral streams.

The objective is to provide techniques that will allow accurate estimates of monthly and annual runoff characteristics for streams in the energy areas, with emphasis on intermittent and ephemeral basins.

C. Procedures: The approach will essentially be an extension of work done by Lowham (USGS) and by Craig and Rankl (USGS), who used data available through 1973. Considerable newdata are now available. A regional analysis is being made based on average records, and a time-series analysis is being made of monthly and annual runoff to define time distribution. Channelgeometry methods have been reviewed to determine ways to improve these techniques, which should be highly transferable throughout the energy areas. Special emphasis is placed on coal outcrop and adjacent areas.

D. Report Products: The final report, which will be prepared during FY 82, will summarize data and techniques as well as describing transferability of both.

E. Distribution of Funds:

Salaries	$21,500
Computer	500
Total	$22,000

IV. Potentiometric Maps of Shallow Aquifers in the Powder River Basin, Wyoming

Craig L. Joy, WRD Project Chief (FTS 328-2153)

A. Location: Northeastern Wyoming.

B. Objectives: Potentiometric maps, which are fundamental to understanding the ground-water system, are not available for any shallow horizon in most of the basin and are only rudimentary elsewhere. Potentiometric maps will 1) improve the present knowledge of the hydrologic system in the basin; 2) document impacts of surface mines; 3) provide more information about the relative importance of vertical-versus-horizontal and regional-versus-local movement of ground water.

C. Approach: Wells for which the producing horizon can be related to a mappable horizon for construction of potentiometric maps will be inventoried. Emphasis will be on the horizon of the Wyodak Coal, Felix Coal, and Lakota-Foxhills. Data will be analyzed pertinent to effects of long-term pumping on overlying or underlying aquifers. Mass water-level measurements will be made during two field seasons, concentrating in areas where there is large stress on the system. A water-level change map for the Wyodak Coal on the east side of Campbell County will be drawn.

D. Report Products: The final report, which will be prepared in FY 83, will consist of potentiometric maps for the shallow aquifers. It will be published in the Water-Resources Investigation Series.

E. Distribution of Funds:

Salaries	$ 24,000
Total	$ 24,000

V. Recharge and Discharge through Alluvium of Ephemeral Stream Channels in Wyoming

Craig L. Joy, WRD Project Chief (FTS 328-2153)

A. Location: Wyoming, statewide.

B. Objectives: The Surface Mining Act requires protection of "the essential hydrologic function of alluvial valley floors" by either preservation or reclamation. However, the hydrology of alluvium is poorly understood. The objective of this study is to determine the relationship of water in the alluvium to streamflow and the hydrologic relationship of the alluvial and bedrock aquifers.

C. Procedures: Three concepts of hydrologic functions of the alluvium have been postulated: 1) significant recharge to shallow aquifers occurs from infiltration of ephemeral stream runoff through the alluvium; 2) alluvial aquifers associated with ephemeral streams act as buffers between the channel and the bedrock aquifers; and 3) the loss of surface-water runoff to the alluvium is reflected in the runoff hydrograph shape.

Streamflow, soil moisture, hydraulic properties of channels, and water level data will be collected and analyzed to test the postulated concepts. A stream-aquifer response model and a finite-difference flow-routing model will be used to aid in the analysis.

D. Report Products: The final report wil be prepared in FY 84, and will include data, tests conducted, and the final results.

E. Distribution of Funds:

	FY 82
Salaries	$ 32,000
Travel	4,500
Equipment	8,500
Total	$ 45,000

VI. Lance-Foxhills and Wyodak Potentiometric Maps in the Powder River Basin, Wyoming

Craig L. Joy, WRD Project Chief (FTS 328-2153)

A. Location: Northeastern Wyoming

B. Objectives: Potentiometric maps, which are fundamental to understanding the groundwater system, are not available for any shallow horizon in most of the basin and are only rudimentary elsewhere. Potentiometric maps will: 1) improve the present knowledge of the hydrologic system in the basin; 2) document impacts of surface mines; 3) provide more information about the relative importance of vertical-versus-horizontal and regional-versus-local movement of groundwater.

C. Approach: Improve, by the addition of new data, the potentiometric map of the Lance-Foxhills aquifer published in the Eastern Powder River Basin Coal Statement (FES-1979).

Collect additional data for the Wyodak potentiometric map by active participation in the BLM program for completing coal test holes drilled by the Minerals Management Service as water-level observation wells.

Critically analyze the potentiometric maps (Lance-Foxhills and Wyodak) to test the hypothesis that flow in the coal is predominantly regional flow, and therefore, the coal is a regional aquifer. Alternately, if local flow systems dominate flow in the aquifer, mining the coal will not have a regional impact.

D. Report Products: Final, improved Lance-Foxhills potentiometric map will be prepared in FY 82.

Final report, FY 83, consisting of Wyodak potentiometric surface map, including FY 82 data and an analysis of the potentiometric maps with respect to flow system identification. The final report will be published in the USGS Water-Resources Investigation series

E. Distribution of Funds:

	FY 82
Salaries	$ 21,000
Travel	2,000
Chemical Analysis	1,000
Computer	1,000
Total	$ 25,000

Central Region

I. Channel Geometry Training for BLM Personnel

Bob Hedman WRD Project Chief (FTS 752-2300)

A. Location: Training will take place in Grand Junction, Colorado and Worland, Wyoming. Each training session will last 3 to 4 days.

B. Objective: Teach BLM personnel how to use channel geometry characteristics to estimate annual streamflow and streamflow recurrence intervals. Training will involve classroom instruction and field exercises to teach BLM personnel how to select the channel geometry characteristics and apply them to equations to estimate streamflow.

C. Distribution of Funds:

Salary (including preparation)		$ 3,400
Travel		1,600
	Total	$ 5,000

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